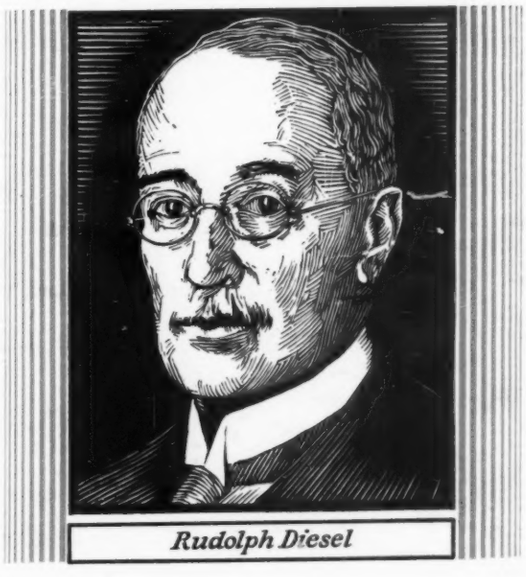
Engineering
Library

JANUARY 1933

JAN 16 1933

MACHINE DESIGN

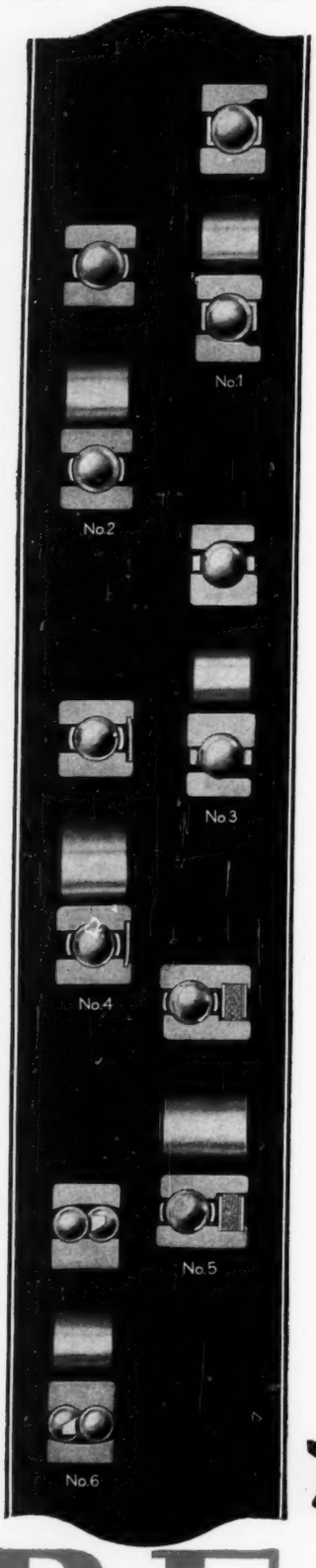


Rudolph Diesel

AS IT AFFECTS

ENGINEERING—PRODUCTION—SALES

PRECISION



FOR PRODUCTION AT LOWER COST

This is the objective of every executive, engineer and designer; and the performance of the bearings in a production machine is a vital factor in keeping costs down * * * * But, in comparing bearings, look beyond first cost—look to the ultimate cost over a period of years. Let proved performance point the way to your decision. * * * * For over 20 years, in every field of industry, **Norma-Hoffmann Precision** Bearings have been making distinguished records for unfailing dependability—records which command the confidence of those who seek the lower production costs that come with the use of better bearings.

PRECISION BEARINGS

FOR EVERY LOAD, SPEED AND DUTY

No one type of bearing is so versatile in its operating characteristics that it will meet all conditions; conditions should determine the type of bearing used. From the comprehensive **Norma-Hoffmann** line—here illustrated in part and briefly indexed—a **Precision** Bearing, or several in combination, can be chosen that will be exactly right for the duty. Let our engineers, with their specialized experience, work with you in selecting and applying bearings that will lower your production costs. Write for the Catalog.

1—Open (separable) type ball bearing.

2—Closed radial type ball bearing.

3—Angular contact ball bearing.

4—Single-plate, grease-retaining, dirt-excluding ball bearing; available in double-plate type also.

5—"7000" Series "Greaseal" felt-protected ball bearing.

6—Double-row, self-aligning ball bearing; also furnished with adapter sleeve and nut.

7—Standard cylindrical roller bearing.

8—One-lipped cylindrical roller bearing.

9—Two-lipped cylindrical roller bearing.

10—Full-type (retaining ring) cylindrical roller bearing.

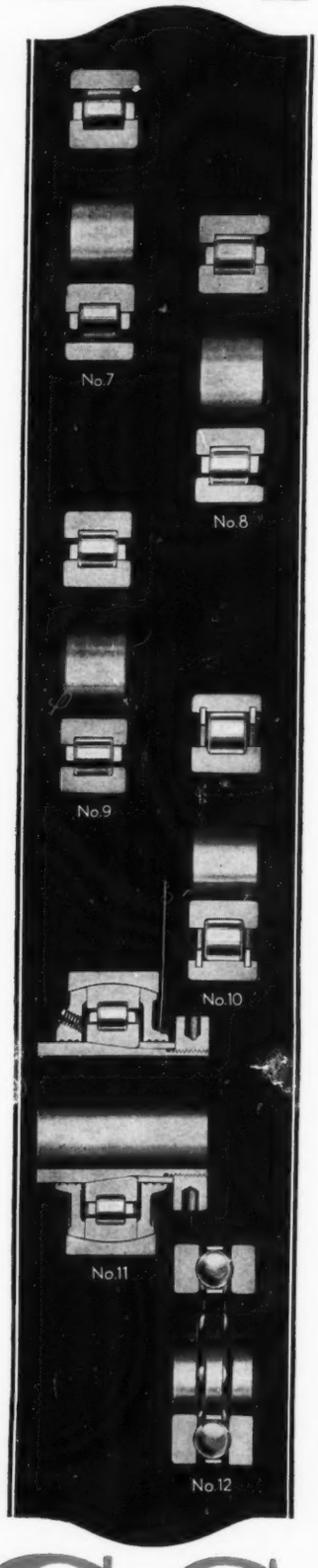
11—Self-aligning adapter type cylindrical roller bearing with grease-retaining, dust-and-moisture-excluding side plates.

12—Ball thrust bearing.

NORMA-HOFFMANN BEARINGS CORPORATION

Stamford, Conn., U. S. A.

"NORMA-HOFFMANN"



BEARINGS

MACHINE DESIGN

THE JOHNSON PUBLISHING COMPANY, CLEVELAND, OHIO

January, 1933 Vol. 5—No. 1

Economy of Torch Cut Parts Permits Refinement

By L. R. Tufts

TODAY'S conditions demand that a new machine shall cost less than earlier models or be capable of doing more work, and consequently represent higher value per dollar expended, if marketed at the same price. In other words, the cost of production of the machine must in either case be lowered by changing, for example, the materials or manufacturing processes. This often results in a machine of similar quality to sell at a lower price or in a machine, to meet the second case, which incorporates refinements permitting higher speeds and faster production.

A pertinent example of the latter is found in the new paper folder developed by Cleveland Folding Machine Co. which embodies both a change in materials and utilization of new processes. From Figs. 2 and 3 it will be seen that the frames of the unit are fabricated entirely from sheet steel. These are cut to shape by the oxy-acetylene cutting torch, a method which is gaining increased recognition in the machinery building industry.

Redesign of the machine to take advantage of this method of production has resulted in considerable economy in manufacture, for numerous reasons. Not the least of these is the saving effected by elimination of machining, details of which will be discussed later. Another advantage, in redesigning the machine, is that the flexibility of the method permitted desirable changes

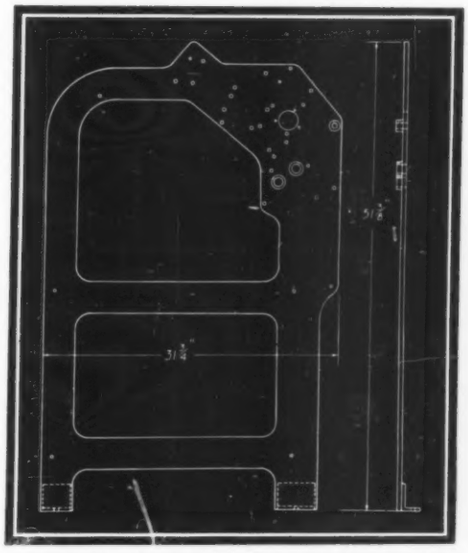
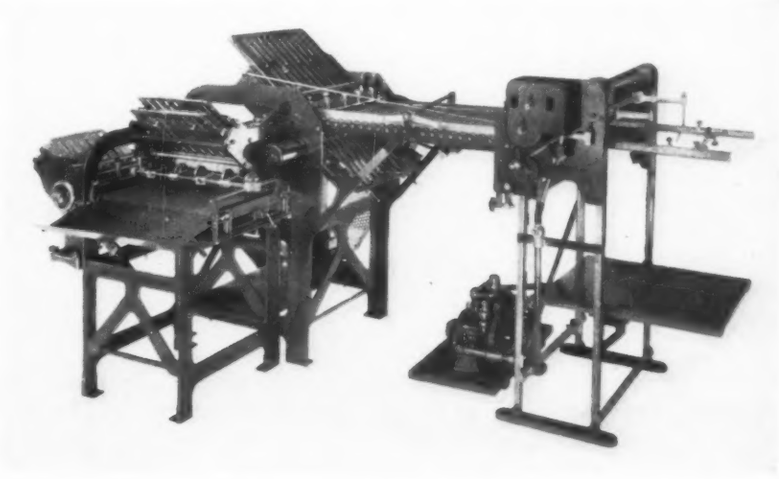


Fig. 1—Torch cut side frame. Fig. 2—(Below)—Assembled machine is similar to earlier models in general style and appearance



to be made to the design of the experimental unit at practically negligible cost. It also was found to be less expensive to build this experimental unit and later to put the machine into production than had been the case with earlier models. Simple fixtures and jigs only were necessary for both the torch cutting of the frames and the drilling of holes. Gas cutting of the frames was accomplished by the pantograph method whereby the travel of the torch is controlled by a templet.

Flexibility of this type of construction not only facilitates development of the machine but also enables changes to be made to standard models

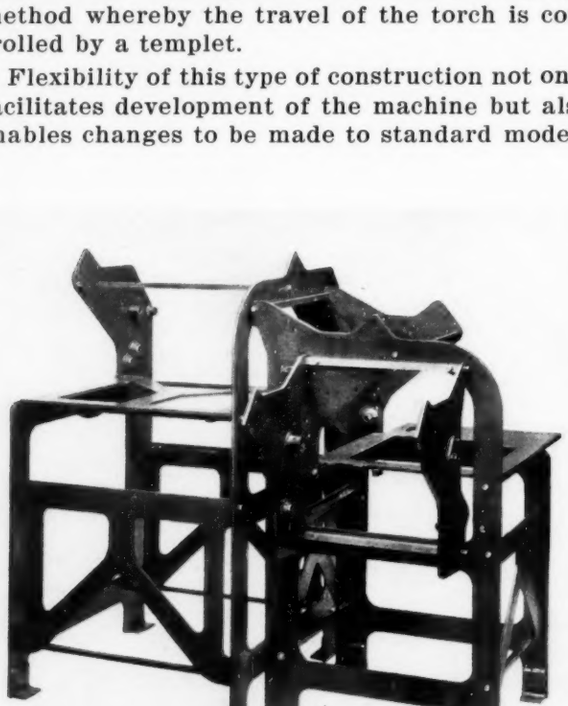


Fig. 3—Side frames are tied together with cold rolled square bars welded to spreader plates

as necessitated by special requirement of customers. Such changes to standard machines obviously are inadvisable and costly, but even so must be made at times. On these occasions the torch cut parts again are advantageous in that they can be changed readily to conform to the individual specifications.

Redesign Facilitates Simplification

Besides effecting reduction in weight without sacrificing but rather increasing strength, redesign of the machine provided an opportunity for simplification by embodying changes not warranted on the earlier model. These were made possible, from the cost standpoint, by the economies arising from the new type of design.

Reverting to the elimination of machining, no milling or planing is necessary on any parts of the frame of the machine, Fig. 3, the only machining required being radial drill work for the holes in the plates and turret lathe work on the bosses and the ends of the cross tie bars. All plates are roll-straightened after torch cutting and press-straightened after bosses and feet are welded in place. Each frame is tested on a surface plate to required limits before assembly. A dead true surface such as obtainable by machine work is, of course, impracticable, but minor inaccuracies which may exist have been allowed for in the design. Conventional set screw collars, for instance are used to provide adjustment of end play in shafts.

Accurate Frame Spacing Obtained

Rigidity of construction and accuracy of spacing of the side frames are obtained by the employment of the cold rolled square tie bars or cross spreader bars. After being turned on the ends to limits these bars are welded to the spreader plates as shown in Figs. 1 and 3 thus giving, on assembly, the open box type of frame construction. Clearance is allowed between the ends of the spreader plates and the main frames, the ends of the square bars projecting beyond the plates and butting against the inner sides of the frames. Bolts are used for drawing up the spreader bars, and while this means that exposed bolt heads are present on the outer faces of the frame members, the expense of eliminating these bolt heads has been considered unwarranted inasmuch as the cost involved would

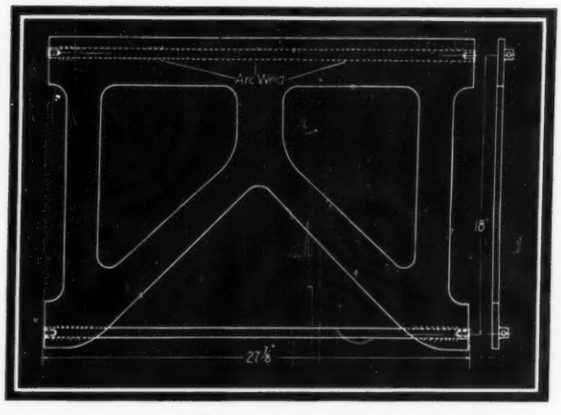


Fig. 4—Square tie bars are machined accurately on ends and held in fixture during welding

make necessary the curtailment of desired refinement in working parts of the unit.

An indication of the accuracy which it is possible to build into this type of construction may be obtained from the fact that the machine is capable of folding accurately sheets of paper as thin as .002-inch, and will stop automatically if two sheets should feed forward at the same time. A further indication, relating to accuracy of frame construction, is that for the paper fold plates, which can be seen projecting at an angle of about 45 degrees above the frame in Fig. 3, specially machined slides have been found unnecessary. These fold plates may require re-

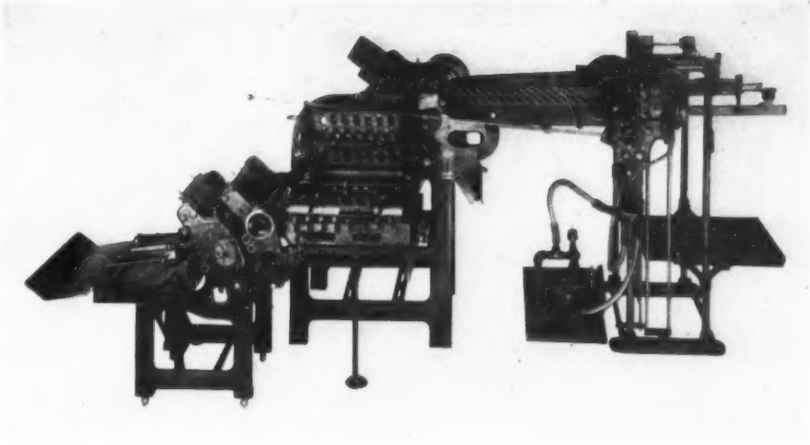


Fig. 6—Earlier model of machine embodying frame members of cast construction

moval manually by the operator several times during setup of the machine. Ends of the plates slide between the inside surfaces of the frame members and the plates rest on cold drawn angles that are bolted to the frames. Eccentric bolts are used, to permit accuracy in positioning.

Little work is necessary in smoothing up the edges of the frame members after torch cutting. While in employing this method of fabrication for the frames of machinery subject to severe stresses it is essential to use extreme care to insure that all surface imperfections such as notches are removed, this is less important in light machinery of the type under discussion. Edges of the gas cut plates can be smoothed readily and satisfactorily by the use of a hand grinder.

Character of Surface Aids Finish

Flat surfaces of the plates are hand rubbed with coarse emery brick to remove any loose scale that may be present after rolling and hand straightening. These surfaces then are sprayed with combination primer and filler paint and later are wet sanded to insure smoothness before finishing coats are applied. It may appear from this that considerable hand work is necessary; the fact remains, however, that the surfaces require less labor than with former methods of construction in obtaining a clean, smooth finish.

One of the refinements in the machine made possible by economies in production is the employment of magnesium castings for parts which necessarily must be lifted by the operator in setting up. A part made from this material is shown in Fig. 5, this being the frame of the cross carrier which conveys the sheets of paper from one section of the machine to another. Use of magnesium reduces the weight of the cross carrier, completely assembled with its rollers, etc., to about 65 per cent of the weight of the same assembly when an iron casting was used.

Fig. 5—Magnesium casting permits considerable weight reduction in part which must be lifted on and off machine by operator

Approve Spur Tooth Forms

DESIGNERS will be interested in the action taken recently by the American Standards association in approving the 14½-degree and 20-degree full depth involute systems for gears as American standards. At the same time the American tentative standard for the 14½-degree composite and the 20-degree stub involute systems, originally published in 1927 was accepted as an American standard. These four widely used forms of spur gear tooth designs will be available shortly under one cover.

The combined standard gives the detailed tooth proportions in terms of both the diametral pitch and the circular pitch for all four designs, and in addition, for the 14½-degree and the 20-degree full depth involute systems, data for obtaining full involute action pinions having small numbers of teeth are tabulated in convenient form. Activities of the body were carried on with the co-operation of the American Gear Manufacturers' association which, with the American Society of Mechanical Engineers, is joint sponsor of the project.

SCANNING THE FIELD FOR IDEAS

A Monthly Digest of New Machinery, Materials, Parts and Processes, with Special Attention to Significant Design Features and Trends

NO ENGINEER can afford to overlook the opportunities of obtaining new ideas . . . industry is built on them. While it is possible to visualize refinement in machines and mechanisms from purely imaginative concepts, there probably is no greater stimulus than that to be found in the consideration of existing designs. In the following paragraphs perhaps may be hidden the basis of an idea which will prove to be the solution to one of your most stubborn problems. Despite the grim prognostications of "Technocracy," such ideas will continue to pay handsome dividends to the designer who can create and invest them.

Actuating Switches by Air Pressure

WHETHER employed to operate in connection with signal apparatus, control unit or similar equipment, the air flow relay developed by E. E. Free Laboratories, New York, provides engineers with a unique device. The mechanism, Fig. 1, is in the category of a push button capable of being operated by air flow instead of mechanical pressure. As shown, the mouthpiece resembles that of the standard telephone.

A case of hard rubber contains two thin phosphor bronze vanes, hinged at their rear extremities and designed to be forced together by air flow as indicated by the arrows. When these vanes are forced together a contact is made at their forward ends. This actuates a relay which can be set to make or break any type of electric circuit.

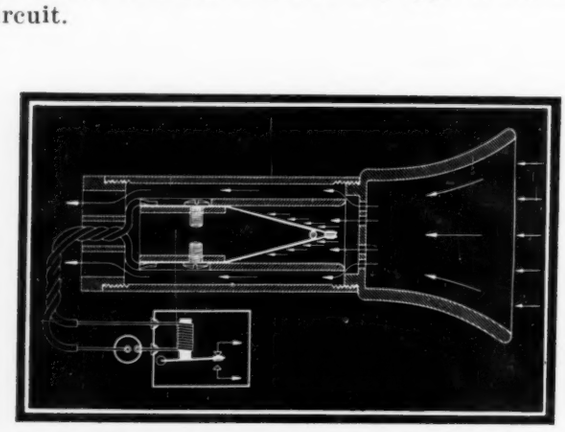


Fig. 1—When air is blown into mouthpiece of switch two phosphor bronze vanes are forced together to close an electric circuit

The device is insensitive to mechanical shock for the reason that a shock in any direction drives both vanes in the same direction without making contact. Force of flowing air or other gas directed against the two vanes is the only ordinary medium which will actuate them.

Sensitivity of the apparatus can be adjusted in two ways; by altering the length or stiffness of the phosphor bronze strips, and by altering the percentages of inflowing air which passes against the vanes through the annular gap between the outer portion of the holder and the inner tube supporting the contact strips. In its usual form the device may be made sensitive to any air flow above a speed of approximately 400 feet per minute.

Some applications of the device which may suggest others, include installation in the control circuit of semiautomatic machinery. Hung on the operator's chest like a switchboard telephone transmitter, it may be employed to stop or start the cycle of the machine without requiring the use of the hands or feet. Office machines offer another example.

Doors also can be opened, elevators operated, etc., by the unit where hand operation is not convenient. It also may be used as an indicator of escape of air or other gases from chemical apparatus and the like, through blowout valves. If the velocities of air flow are high enough the flow can be held constant. This was discovered when air flow from an electric fan was held constant by utilizing the device to turn on the fan when air speed fell too low, and off when it became too high.

Unconventional Use of Rubber Tire

DRIVING arrangements are confronted in the design of practically any kind of machine. Consequently there is a constant quest for ideas relating to various types of drives and the ways and means by which they can be incorporated to advantage. Among recent developments in this direction is the electric driven monorail trolley originated by American MonoRail Co.,

Cleveland. New features include primarily the use of a standard rubber tire to drive on the bottom of the monorail section, Fig. 2. An airplane skid wheel tire is used, proving the feasibility of applying commercial units to special purposes.

High coefficient of friction between the tire and steel rail provides a nonslipping grip. Rail wear is eliminated and control problems simplified. Structural simplicity is effected by driving one wheel instead of the conventional two or four wheels. Motor reducer units characterized by their compactness which is a distinct advantage in this installation, are employed. Where close control is required, variable and multi-speed motors may be employed, but on many applications, due to high traction between the wheel and the rail, it is possible to use a simpler and generally preferred squirrel cage motor with push button control.

The new type of drive permits the use of power travel on narrow flange rails which previously was impractical because of the limited tread width available causing high flange and wheel wear. The wear now occurs only on the replaceable tire. Peening down of the rail

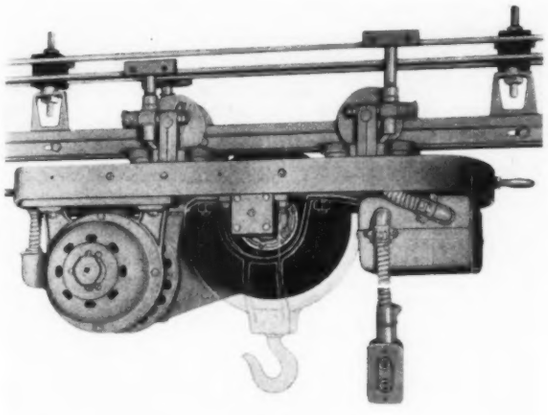


Fig. 2—Monorail conveyor trolley employs standard rubber tire to provide nonslipping grip on rail

flanges under driven wheel action also is eliminated. This development is exemplary of the possibilities of rubber wheels in friction drives and should suggest further application, particularly in materials handling equipment.

Producing Hot Water Continuously

UTILIZING a solenoid valve, mercury switch and an electric heating unit, a water heater has been developed which offers an ingenious arrangement for producing hot liquids continuously and automatically. Shown in Fig. 3, the unit, manufactured by Globe Machine & Stamping Co., Cleveland, occupies 9 inches of space and stands 21 inches high.

The controlling factor of the heater is the float located at the top of the reservoir. From this float a control rod extends downward connecting through an elastic bellows to a pivoted mercury switch in the base of the unit. Assuming that the reservoir is full when water is

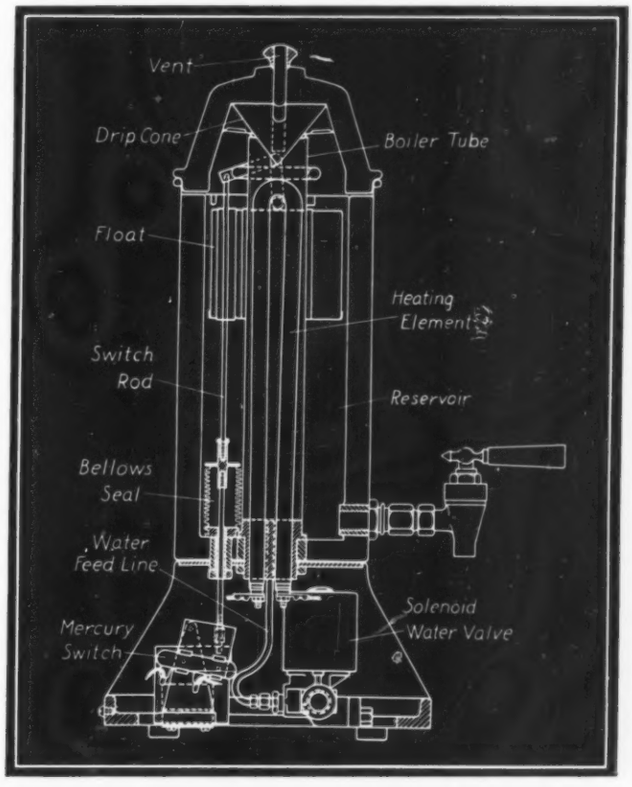


Fig. 3—A solenoid valve actuated when a float-operated mercury switch is closed and heating unit energized, makes possible a continuous supply of hot water

drawn off, the following automatic cycle takes place.

As the float descends with the water in the reservoir the mercury switch is leveled off to contact. Current energizes the 1500 watt hair pin heating element in the central boiler tube and also actuates the solenoid valve in the base of the unit, permitting water to enter the base port of the central boiler tube. This cold water rises around the heating unit in the tube and by the time it reaches the top and overflows into the reservoir it is boiling. When the reservoir is full (one quart) the float cuts off the current and the primary cycle is completed.

The secondary operating cycle is concerned merely with radiation loses. At the bottom of the reservoir is located a 125-watt cartridge heater which is controlled by a thermostat also at the bottom of the reservoir. This combination maintains the predetermined temperature of the water in the reservoir at all times independent of the primary cycle.

In accordance with thermoelectric standards a 1500-watt heating element such as used in this unit will boil 3 to 3½ gallons of water per

hour as an ordinary immersion element. In the new heater however, this same element boils 5¾ to 6 gallons per hour for the reason that it is a recuperative heater and the entire amount of British thermal units is being absorbed at one time by less than two cups of water contained in the central boiler tube. The rate of production of boiled water, cooled to 189 degrees, therefore is slightly more than two cups per minute.

The water heater provides an outstanding example of what can be accomplished by combining mechanical and electrical units and should stimulate further action in this direction.

More Streamlining in Railcars

VAST changes in design are characterized by the radical developments in railcars which have been put to test here and abroad. The railroads, long criticized for their antiquity, seem to have caught the motif of modern transportation requirements. The latest addition is the torpedo-shaped aluminum Autotram, Fig. 4, built by Clark Equipment Co., Battle Creek, Mich. This is capable of operating on fast schedules over standard rail beds and seats 42 passengers. The car should prove to engineers that the railroad industry still is one of the fertile machinery markets.

Streamlining has been followed throughout. As urged by MACHINE DESIGN many times in the past new transportation equipment deserves increased attention to streamlining. Not only has the contour of the Autotram body been designed to reduce wind resistance to a minimum but aeroplane practice has been followed to the extent that all exposed struts and guards have been shaped to offer the least amount of resistance.

Aluminum was chosen for the body not only for its light weight but because of its high strength per pound of weight and its capacity to absorb stresses and strains. Safety glass is used in double windows and the entire passenger compartment is sealed against heat, cold, dust and noise. An air conditioning system provides ventilation.

Power is furnished by a 16-cylinder gasoline engine, tractive effort being communicated to the wheels through a series of special clutches, transmissions, and axles. The body is supported on two trucks after the fashion of the standard railroad vehicle. The trucks, however, are of radically different design from those of the conventional railcar. Trucks swivel in rounding curves and power is applied to the front wheels.

In connection with the Autotram it is interesting to note that engineers in the rubber industry also were engaged in its development. These Goodrich technicians were responsible for the wheels. Four disks of specially compounded rubber ¼-inch thick and 1¾ inches wide are placed in each wheel under lateral compression. The load is carried entirely by shear, with no load compression on the rubber. Early work on the wheels contemplated the use of a pneumatic rubber tire. This work still is in progress but for many reasons it appears now that a steel-tired, cushioned wheel is more suitable to railroad requirements.

Torch Hardening Merits Consideration

THAT necessity is the mother of invention may or may not always hold true but it might have been responsible for the development of torch hardening in England during the World war. The first extensive application of this process of localized heat treating was to

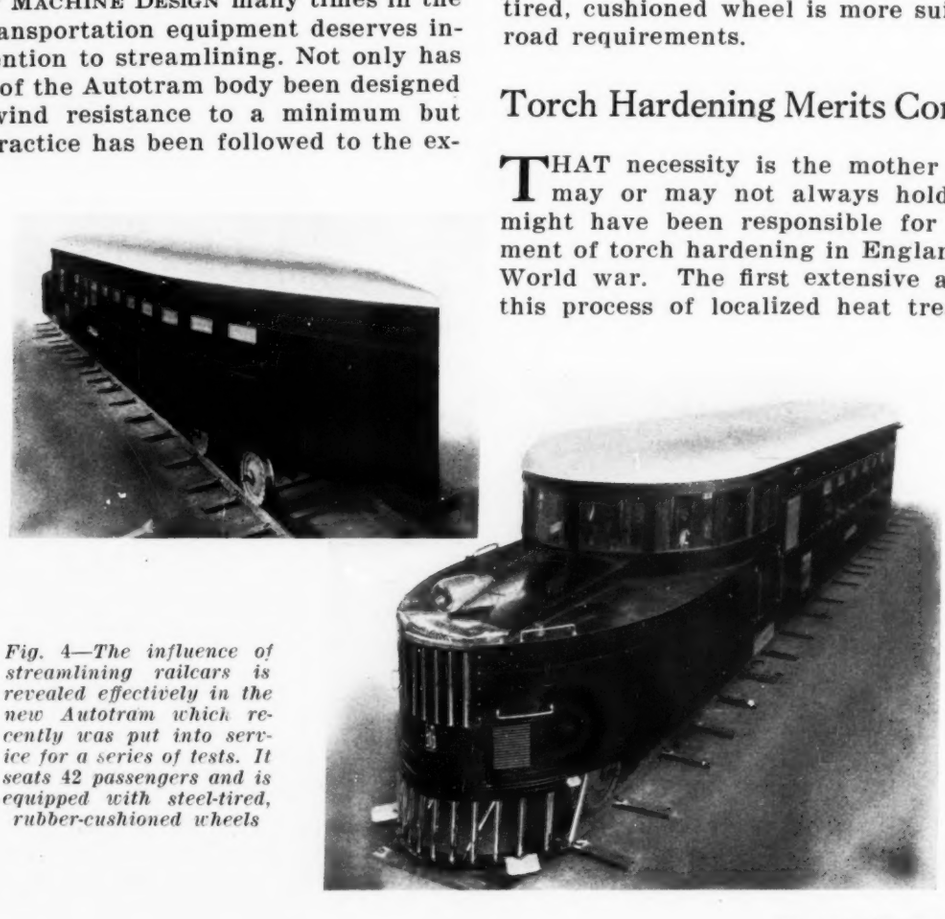


Fig. 4—The influence of streamlining railcars is revealed effectively in the new Autotram which recently was put into service for a series of tests. It seats 42 passengers and is equipped with steel-tired, rubber-cushioned wheels

rails of a line of railway track which under war conditions were wearing so rapidly as to make replacement imminent.

Since the rails had a carbon content high enough to permit hardening, there was devised the scheme of playing an oxyacetylene torch along each rail slowly enough to bring the surface to a visible red heat, and following closely with a stream of water to insure a sudden quench from the red. Thus the top surfaces of the rails were hardened and the life of the lines prolonged appreciably.

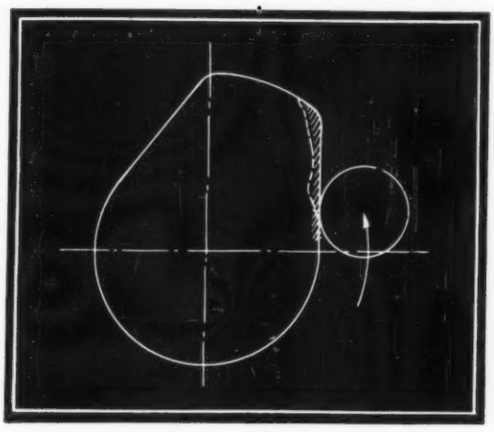


Fig. 5—Torch hardening may be applied to cams where rollers cause excessive wear

Success of this venture led to its more general application. One of the most extensive, according to W. H. Himes, Pittsburgh, has been the hardening of teeth of gears and pinions. Hardening by this method is used by one manufacturer in this country in cases where hardening of gear teeth by conventional methods is difficult or impossible. The process has been employed mainly with carbon steels; its use with alloy steels is more difficult, and with some alloys it is not practicable. Hardening characteristics of any alloy steel should be studied carefully before attempting its treatment by this method.

One of the more obvious applications of torch hardening, Mr. Himes asserts, is that of cams, Fig. 5. These parts usually wear unduly at the point where the roller impacts against the rise. Cams made of 40 per cent carbon steel or higher can be hardened cheaply on the approach side of the rise after being machined. This process can be substituted readily for case hardening in many instances with considerable saving. When the piece is fed under the flame and the quench stream by a screw feed a uniform case, controllable as to depth, can be developed.

Thrustor in New Application

IN THE application of a thrustor to a mechanism for ejecting clay pigeons at a New York gun club is seen a unique idea. Engineers of the General Electric Co. worked out the process. The trap is connected with the club house by wires and the operator controls the ejecting device from a distance. When the captain of the shooting team gives the signal the operator depresses a push button with his foot. This energizes the thrustor which pulls back the ejecting lever. The lever is caught by a trigger and held for a brief interval, whereupon a solenoid releases the trigger, ejecting the pigeon. The operation is entirely automatic.

Utilizing Hydrostatic Pressure

HIGH centrifugal force is being employed increasingly in liquid clarification and separation problems. Augmenting units developed for this class of service is the Rotojector, Fig. 6, designed by the Sharples Specialty Co., Philadelphia. The mechanism employed incorporates a specially constructed bowl which consists of an inner bowl sliding in a casing to uncover an annular slot for the discharge of solids while the bowl is running at full speed. Designers will find this feature interesting and suggestive of wider application.

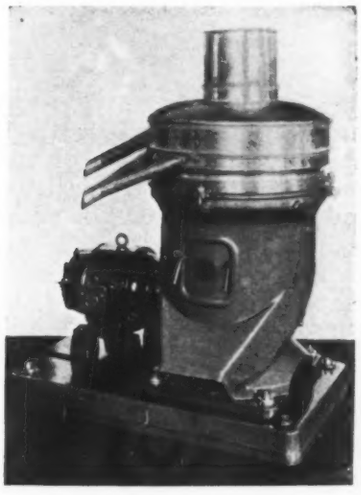


Fig. 6—Hydrostatic pressure effects opening of bowl in this Rotojector for liquid clarification and separation

Opening of the bowl is accomplished by the hydrostatic pressure in a layer of water charged into a separate operating chamber. The pressure is generated by the rotation of the bowl and works against eight springs which tend to close the discharge passage. This pressure amounts to nine tons, but is generated and released so quickly that opening and closing of the bowl are accomplished within 10 seconds. Since no passage exists between the bowl and the pressure chamber there is no possibility of contaminating the liquid being treated, with the water employed to unload the bowl.

Considering Design from the

Part II—Forging

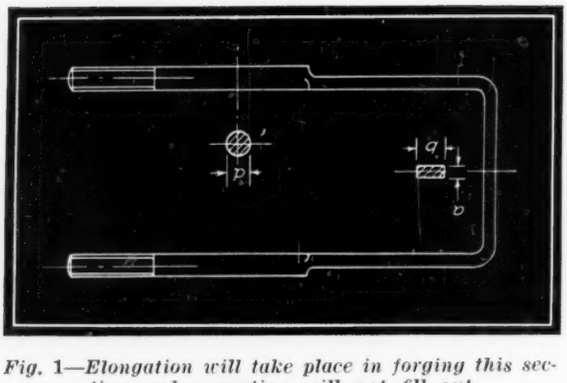


Fig. 1—Elongation will take place in forging this section and a portion will not fill out

CONTROL of the metal flow in steel forgings so that the fiber is oriented to provide the greatest strength is one of the most important considerations in the design of parts to be produced by this method. A small variation in the design may bring about a large difference in ultimate strength as the direction of fiber may be such that a certain portion of the part will fail long before the remainder is stressed proportionately.

The possibilities of steam hammer and hydraulic press forging are much the same as those afforded by simple blacksmithing unless dies are provided, the improvement being more a matter of force than of technique. The tools used in the village smithy are found in essentially their original forms in the forge shop. Ingot or billet may be flattened and spread, or rounded or drawn by concave or vee pallett swages on anvil and tup.

Limitations of hammer and press swaging with only transverse confinement of metal in swage blocks are based entirely on the necessity of the metal to escape longitudinally. Thus the forge shop may be asked to produce a stirrup, Fig. 1, in which the areas $a \times b$ and $\pi d^2/4$ are equal but it cannot forge section $a \times b$ under the hammer from a round of d diameter nor section d from a flat of the dimensions $a \times b$. Some elongation will take place in either operation and one dimension or other will fail to fill out. If this job is to be made cheaply from the bar without upsetting, for which it is too long, the area of the forged section should be reduced to not more than 75 per cent of the rolled section.

Suppose a crankshaft flange is required as in forging drawing Fig. 4 in which $D = 2\ d$. Let us assume that it has been worked down from the ingot to something like the dashed lines.

A volume of metal $(\pi D^2/4 - \pi d^2/4)\ l$ must be displaced. If we try to do this by forging on the neck only, we may not begin with a width greater than $1/3\ l$ as flow will start at once, carrying the flange away. Forging down to d and upsetting the flange might be suggested. There are several things against this. It is not possible to stand a long job under the hammer or press; and on account of the slender neck and large flat offset the job needs to be gripped and backed up by a die which is only possible on the upsetting machine, rarely met with in this size. Most likely the forge man will cut this neck out on a lathe, losing the benefit of hot working. The remedy is to make flanges like D as small in diameter as possible. The bolting usually is amply strong in shear without increasing bolt radius in spite of which large flanges thoughtlessly specified have increased forging costs greatly.

It is desirable to forge the gap shown in the drawing but there is no place for the metal to go without unduly lengthening the pin, so the hammer forged crankshaft is gapped by machining. This leaves the line of segregation across the arms at x - y, the usual point of failure.

The obvious remedy for all of these conditions is to forge the shaft approximately to the required sections and bend it. Small shafts of this sort bent from rolled bars

Fig. 2—Steps in the production of gears by upsetting to produce grain flow as shown in Fig. 5

on the Production Standpoint

By Harold F. Shepherd

in single dies have been common but the bends generally are much rounded unless made on the upsetting machine and the main journals are further apart than good design of heavy duty machinery permits. Drop forgings meet the design requirements but are not available in large sizes or small lots.

The die press process seems to offer the ultimate means of producing large forgings accurate in form and dimensions with an equipment cost so low that it is soon absorbed by the saving in machine work on the product.

Since dies worked under a hydraulic press are not subjected to blows they may be cast in steel, the impressions requiring only a moderate amount of finishing rather than the removal of a great mass of metal by sinking and offsetting.

In the instance of crankshaft forging, the dies are primarily for bending, the metal being

Fig. 3—Controlled direction of grain flow in forging with dies strengthens crankshaft

worked previously under the press from ingot size to the rough diameter of the journals. Skill is required to design the dies so that stout arms of rectangular section are formed without excessive forging and flash. At the same time enough metal must be present between the initial reaction points in the dies to upset into the radii at the arm ends which are smaller than those natural to simple bending.

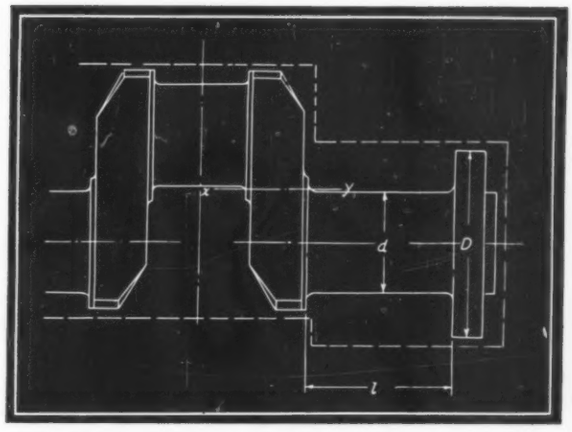


Fig. 4—Shafts of these specifications should be bent after forging to the approximate size

For this reason the engineer should collaborate with the forge master in designing relative arm and journal sections. Collars ⅛ to ¼-inch wide should be left at pin and journal ends to allow machining to length without cutting into arms in spite of slight variations in centers of individual cranks and a reasonable amount of draft must be allowed lengthwise of the arms. In Fig. 3 the cross sections of arms are about 50 per cent of the areas of the pin and journals in forged state and nearly equal when finished. Examples show arm sections of 75 to 80 per cent of rough journal area, stout enough for any purpose.

Test pieces cut lengthwise of the arms of these forgings show elongation and reduction of area equal to that in any other part of the forging. This is in decided contrast to crankarms cut from the billet in which test pieces cut out of the arms are stressed transversely to the grain and ductility is reduced seriously.

Drop forgings are attractive for their accuracy, appearance and indestructibility for small parts. They may be attractive from the cost viewpoint without losing beauty if so designed that they can be made in simple dies sunk with the least possible amount of cherrying, chipping and riffling.

In spite of the fact that a forging of any form may be smashed out of a piece of white hot steel the probable flow of metal in the die should be considered. If upsetting or elaborate breakdown dies are required to prepare the steel for final drop forging the die cost may be doubled. If several strippings of fin or flash are required

before the dies are able to close on account of excess metal in some section the production cost for man and equipment is increased greatly.

For examples of good and economical practice it is well to study how the drop forger himself designs for those products which he forges, finishes and markets under his own trade mark. These products show planning to displace the

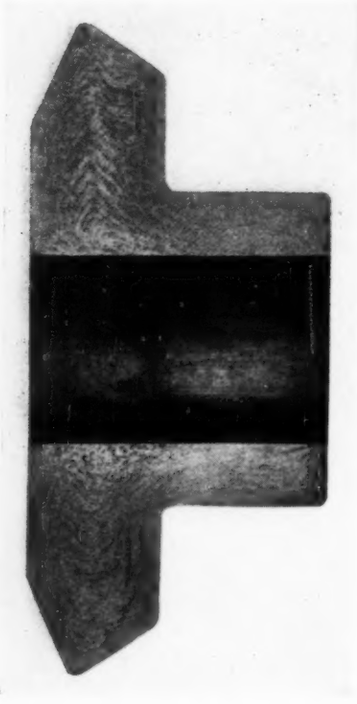


Fig. 5—Grain flow the same in any radial plane is preferable to individual fiber orientation

sections of a bar laterally rather than endwise, a flow which is restrained by die and flash. Their sections are constantly varying but the areas at any transverse plane are much the same.

For drop forge dies the rules are the same as to parting and drafts as in pattern making with less opportunity for exceptional methods permitting departure from the elementary principle. Draft is standardized at 7 degrees for ordinary cases but may be increased to 9 degrees when enlarged ends make removal of the forgings difficult due to its shrinkage, and further increased to 15 degrees for plug insets used to blank out holes. As these drafts influence the appearance and dimensions of deep forgings considerably they should be shown to scale on the drawings.

Mild Steel Should Be Used

High carbon and extremely tough alloy steels may be drop forged but economical practice demands use of mild steel wherever possible, hardness being acquired by carburizing and subsequent heat treatment.

The forging machine of the upset type, descended from the bolt and rivet heading machines, has contributed marvelously to production. Often ill cared for and installed in some dark corner its possibilities in the hands of a capable die designer are seldom suspected.

Its mechanism is comprised of a mainshaft with center crank connecting rod and crosshead or slide for carrying the heading or upsetting dies. These operate against split dies one of which is fixed and the other being movable transversely under the influence of a powerful motion often using both toggle and wedge advantages. These are the gripping dies used to hold bar stock when it is being upset or otherwise formed and also serving to swage and to shear. The heading slide may carry a number of tools mating with corresponding split gripping dies and used successively for bending, forming, piecing or punching.

Many of these dies while ingeniously devised may be made on ordinary machine tools at moderate cost. For this reason forge companies using these machines often are able to make attractive prices on small lots that might otherwise have to be machined from solid.

The unique feature of this process is that it operates from three sides and by working out of the top of the die an additional fourth side operation is possible.

Gears produced by upsetting Fig. 2 have the grain distribution shown in Fig. 5. It is the same in any radial plane, a condition preferred to the parallel grain of blanks struck from flat stock in which case each tooth has an individual fiber orientation.

Maximum Possible Upset Given

This process has its laws stated by E. R. Frost as follows. Maximum possible upset is three diameters of bar length, Fig. 6*A*, page 56. If this is exceeded bending of the stock takes place.

Lengths of stock more than three times the diameter of the bar can be upset successfully in one blow provided the diameter of the upset is not more than one and one-half times the diameter of the bar, Fig. 6*B*.

In an upset requiring more than three diameters of stock in length and in which the diameter of upset is one and one-half times the diameter of the bar the amount of unsupported stock beyond the face of the die must not exceed one diameter of the stock.

Flow of metal, of equal importance, often is bettered by cone upsets as in Fig. 2 and perhaps in this as in other cases the designer may assist his imagination by working on a plastic material with simple wooden forms simulating dies.

Other processes producing cheap products of excellent physical properties and grain disposition are: Cupping, in which a plate is driven through a die to form a tube with one closed end. (This is distinguished from drawing by the absence of any ironing member to exert a pressure on the stock and by its being a hot process); swaging of tubing and rods in the rotary swaging machine which tapers or shoulders as desired; and spinning by which plates are flanged over a die rotating in a lathe by the pressure of a roll or blunt tool. Tubes are swaged or closed by the same operation, the heat generated by the

(*Concluded on Page* 56)

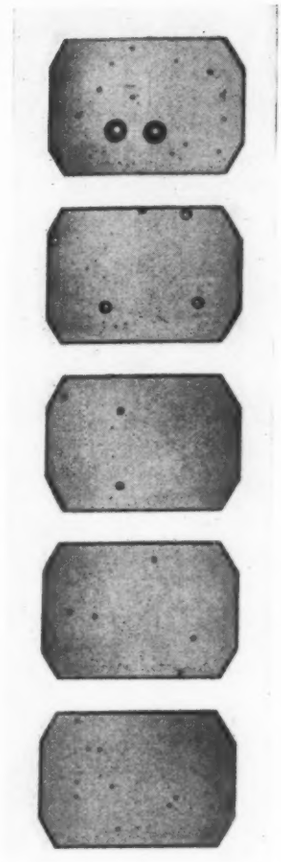
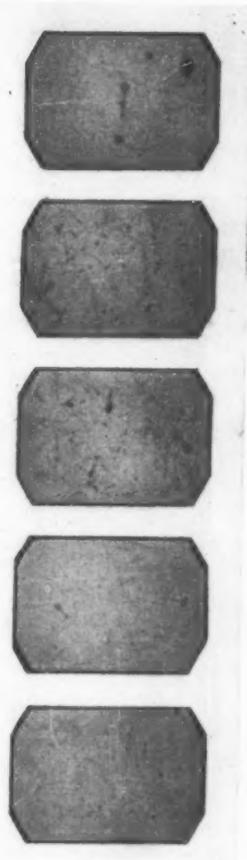


Fig. 1— (Left) — Drops of lubricant thrown off rotor at speeds ranging from 1000 to 5000 revolutions per minute

Fig. 2— (Right) — Drops of non-lubricant thrown off rotor show characteristics differing from those of lubricant



Chemical Aspects of Lubrication

WHILE lubrication phenomena usually have been handled by mechanical engineers, the problem of lubrication lies more properly within the purview of physical chemistry. This has led to rather unfortunate misapprehensions at times that have emphasized certain properties of lubricants which do not have the values ascribed to them. The purpose of this discussion by William F. Parish and Leon Cammen is to present a simple picture of the phenomena occurring when a lubricant comes in contact with a metallic surface. These data supplement their earlier investigation into the new theory, described in the August, 1932, issue of MACHINE DESIGN. Both investigations have been covered at meetings of the A.S.M.E.

Films of lubricant should separate metallic surfaces sufficiently to prevent interference of electrical fields of the shaft and the bearing which produces heating. In addition, this separation should be sufficient to prevent the actual rubbing of the rough faces that exist even on the best machined and ground surfaces, which also is a source of heat.

In order for the film of lubricant to fulfill its two primary purposes it should adhere with reasonable tenacity to the surfaces of the shaft and the surface of the bearing, and the body of free film of oil located between the two local films should have reasonable cohesive properties. This is determined partly by the properties of the lubricant and partly by such mechanical factors of lubrication as the pressure under which the oil is supplied and the pressure built up by the action of the shaft in forcing the oil into the wedge-shaped space between its shaft and the bearing. The factors that determine the ability of the lubricant to maintain the films between the shaft and the bearing are the cohesion between the molecules of the lubricating fluid and the effect upon the structure of the lubricant, if any, produced by the presence of the shaft and the bearings.

The mechanism of adhesion is fairly well known. Hardy maintained that the adhesion of a liquid to the surface of a shaft was due to the presence of electrical forces on the shaft and on or around the molecules of the liquid, and that the presence of these forces produced an orientation in the molecules of the liquid and probably also, although to a much lesser extent, in the molecules of the material of the shaft.

Lubricants Are Defined

Without attempting to express the phenomenon in quantitative terms, it may be stated qualitatively that a lubricant is made up of asymmetrical molecules surrounded by asymmetrical fields of force, the predominating polarity of which is of a sign opposite to that of the field of force emanating from the metal of the shaft, the greater field of force being of a magnitude sufficient to produce a certain, as yet unknown, amount of adhesion of the molecule to the shaft, but insufficient to produce excessive attachment or to create an excessive amount of cohesion between the molecules themselves.

It follows that, since the molecules of the first layer of lubricant have oriented themselves with

respect to the metallic surface of the shaft so as to present a field of force whose polarity is of opposite sign to that of the metallic surface, the molecules of the second layer will orient themselves similarly. In the same way a third layer will arrange itself and consequently a series of layers of oriented molecules will be formed, each one of which is held by a loose bond to the preceding one until orientation finally becomes irregular, and the internal forces of the liquid alone prevail.

In order to investigate the phenomena taking place in a layer of lubricant in contact with a metal shaft or bearing, the Sperry-Cammen tester, Fig. 3, was developed. The underlying principle of the method of testing embodied in this machine is the determination of the adhe-

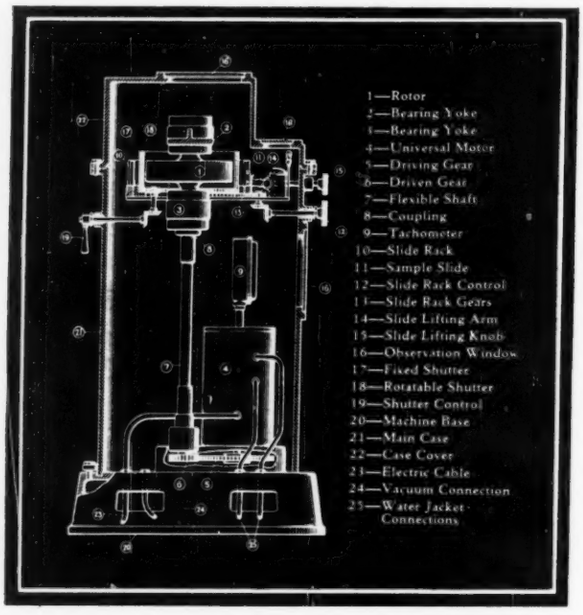


Fig. 3—Lubrication tester which was employed in obtaining slides showing the nature of the drops

sion of liquids to solids by measuring the centrifugal force needed to separate them from the metal surface. For purposes of observation and study, the droplets thrown off a moving rotor are caught on glass slides. Obviously, in the case of a single homogeneous liquid a given centrifugal force will throw off drops of the liquid that represent successive layers of it on the surface of the rotor.

In the case of a liquid of simple structure the droplets hurled from the surface of the rotor will be of a substantially uniform size that will bear a certain functional relation to the centrifugal force developed by the rotation, and in the majority of cases, will be of irregular shape. This is well illustrated by the sampling slides of Figs. 1 and 2, a lubricant and nonlubricant respectively, being used for the test.

In the case of a liquid consisting of at least two components, either in solution or suspension, but particularly in solution, there are further complications. Assuming that the two components of the liquid have different forces of adsorption, the first layer of molecules of this liquid in proximity to the metal of the shaft will consist of those of the component with the more powerful attractive fields. The attraction between this component and the metal of the shaft is so much greater than that of the other component that the latter will be completely displaced.

The same thing probably holds true for the material filling the cavities in the metal. A short distance from the shaft, however, as measured in layers of molecules, the intermolecular attractions are weakened so materially that the interspaces between the molecules of the component, that is the true lubricant, will be filled by the matrix liquid. This condition will become intensified progressively until in the so-called free film substantially the equilibrium proportion between the true lubricant and matrix solvent will prevail.

Interrelation Exists Between Liquids

Apparently there is an interaction between the film of lubricant on the surface of the metal and the liquid within the cavities of the metals, particularly where the cavities exceed a certain size. From the fact that there exists an interrelation between the liquid within the cavities and that present as a film on the surface, it would appear that when the external film is removed, it is immediately replaced by a new film produced by the discharge of lubricant from the cavities in the metal. This process is illustrated by the "wipes" (M. D. August) obtained on the testing machine by wiping the surface of the rotor clean with a piece of paper. If the rotor is then run at a speed of 6000 revolutions per minute, a new film of lubricant appears on the rotor surface. Increasing the speed still further causes the rupture of this new film and projects droplets of it on to the slides, as shown in Figs. 1 and 2. Incidently it will be noted that in all cases the drops thrown from the rotor at any given speed are of more than one size.

In conclusion the investigators state that practical experience with reclaimed oil tends to prove that sludges, waxes, etc., in lubricating oils fill up cavities in metal surfaces of shaft and bearing. If these are removed from the oil, a more perfect lubricant will result. Specifications of lubricants should contain, in addition to data on viscosity, data on the surface tension of oils and "standard sampling cards' showing the character of the drops thrown off the rotor of an oil tester at a specified speed of spinning. An ideal lubricant is one with a maximum coefficient of adhesion of the "true lubricant" to the given solid surface and a minimum coefficient of internal cohesion in the solvent matrix.

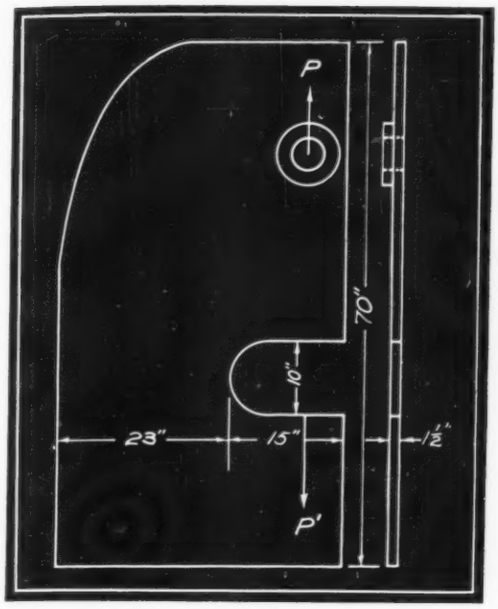


Fig. 1—Outline and thickness of a steel side frame reproduced in rubber

Rubber Models Insure Accurate Stress Analysis

By Robert E. Kinkead
Consulting Engineer, Cleveland

REDUCED scale models tested with static loading and strain gages offer a satisfactory method of stress distribution analysis where the structure is large and the cost of such work may be justified. But, with the strain gages now available, such models must be of considerable size to permit application of the gages. The strain gages may involve a considerable capital outlay and the models are expensive when made accurately.

Where a polariscope is available analysis of stress distribution in scale models made of bakelite, celluloid or glass with monochromatic light gives results of relatively great precision at reasonable cost for the models. The principle involved in this method is that stress distribution is independent of the material so long as the material is homogeneous and isotropic. The principle, of course, holds only for equal amounts of deformation. The error in using any of the above named materials is negligible. Defraction and interference bands formed by polarized light passing through a stressed model offers a practical means of evaluating stresses at any point in the stressed model. Heretofore the initital cost of polariscope and incidental equipment for this work has restricted the use of this valuable and precise method of stress analysis.

The Maybach Motorenbau G.m.b.H. in Germany recently has patented a method of stress distribution analysis which is applicable to relatively small parts of engines such as crankshafts, connecting rods etc. In this method the part is painted with a newly developed lacquer which will show cracks at relatively light loads, form more cracks as the load is progressively increased but will not scale off before the yield point is reached. These cracks show the distribution but not the magnitude of the strains (and therefore the stresses). The magnitude of the surface strains is determined by use of a device of the general nature of a strain gage. To permit the designer to visualize the magnitude and distribution of the stresses, a wood model is made with pins driven into it. The length of each pin is proportional to the magnitude of the stress at the point at

Readings from Rubber Scale Model Under Relatively Light Loads

Measured		Calculated		
Pull lbs. *P*	Deformation inches *d*	Elongation actual inches	Elon gation per cent	Max. Stress lbs. per sq. in.
0	None	None	None	None
	Reading—0.330			
1	.340	.01	3.03	22
2	.350	.02	6.05	41
2.25	With no bracing, buckling occurred at this load.			
3	.360	.03	9.10	57
4	.370	.04	12.10	75
7	.400	.07	21.20	126
8	.410	.08	24.20	142

which it is driven. With this information before him the designer can place the material in the part in such a way as to carry the load most advantageously and avoid excessive stress concentrations.

Plaster of Paris Method Devised

Another recent method of determining maximum boundary stresses, and in certain cases internal shear stress, has been developed by R. J. Roark and R. S. Hartenberg of the University of Wisconsin. This method involves the production of a scale model in plaster of paris and testing to destruction to find where the model will fail and at what value of the stress. Skillful interpretation yields results which are comparable to those of the Maybach method.

In both the Maybach and the Roark-Hartenberg methods it should be observed that the results are based on parts made in three dimensions. Polarized light measurements made on transparent models is limited seriously in the matter of investigating the behavior of three-dimension scale models.

For a good many purposes, reduced scale models made of a suitable rubber will give results which are sufficiently precise for the machine designer's purpose. G. S. Chiles and R. G. Kelley described a method of qualitative analysis of stress distribution based on the use of rubber in 1919. Charles F. Kettering of General Motors research laboratories has used the rubber models for qualitative analysis in crankshaft design. The writer used the rubber specimens for qualitative analysis of stress distribution in welded joints several years ago (Note: *Weld Design and Production,* Ronald Press, 1930). Improvement of the quality and method of manufacture of the rubber used for this purpose and a decidedly improved technique now make it possible to obtain quantitative results of satisfying accuracy with reduced scale models made of rubber.

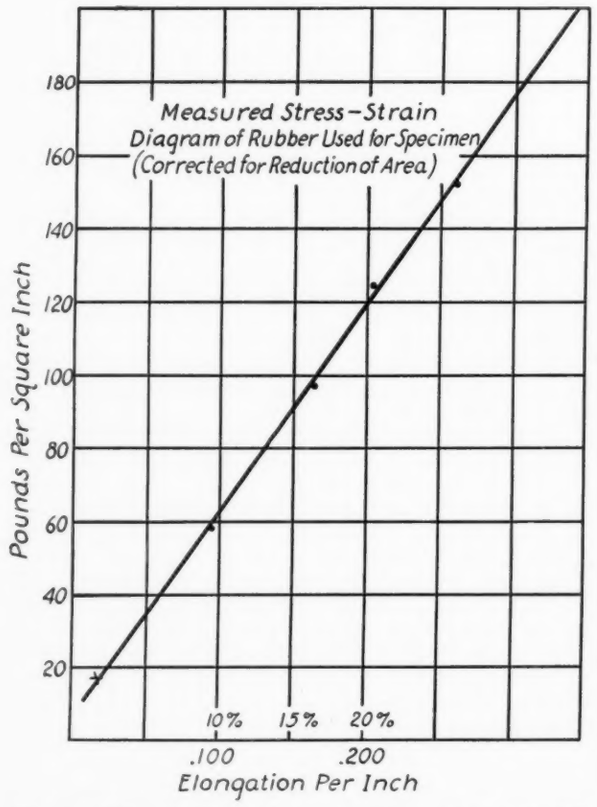


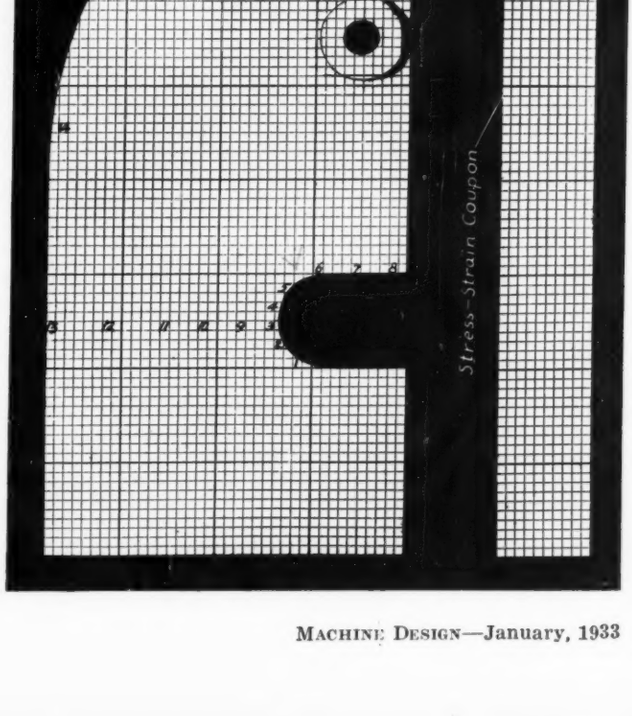
Fig. 2—(Above)—Preliminary measurement of material used in model. **Fig. 3**—*(Right)—Rubber model on which deflections can be measured made one-tenth actual size and thickness*

Models Easily Produced

To illustrate the use of rubber for this purpose, a preliminary analysis of a steel side frame is furnished herewith. Fig. 1 shows the outline and thickness of a proposed frame which a designer wished to investigate for stress distribution. With a kit of simple tools and some special rubber now available for this purpose the designer can prepare the reduced scale model without leaving his drawing board.

Fig. 3 shows the rubber model made one-tenth actual size and thickness. The numbers are placed on the specimen for convenience in making repeated measurements at the same place. The problem is to find the location of the maximum stress and evaluate it in terms of reaction at *P,* Fig. 1.

The first step is to measure and plot the stress strain diagram of the particular piece of rubber



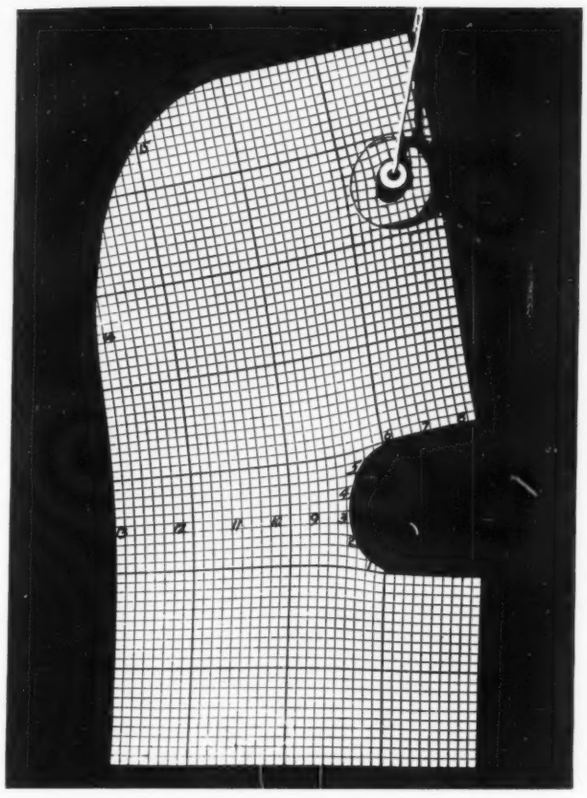
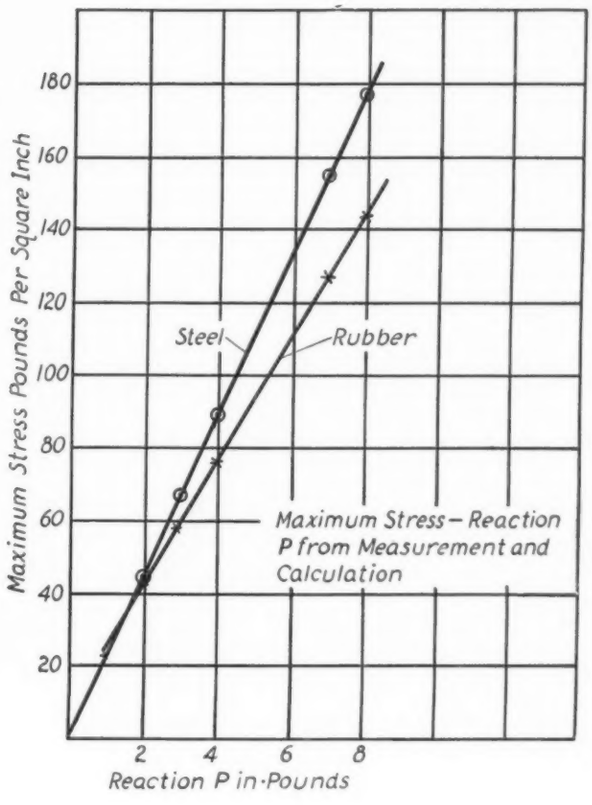


Fig. 4—(Left)—Specimen under relatively great load shows nature of deformation. Fig. 5—(Below)—Degree of stress concentration in terms of reaction can be determined



from which the scale model was made. The specimen for this purpose is shown in Fig. 3. The stress strain diagram is plctted in Fig. 2.

By trial and error methods it is established that the locality of maximum stress concentration will be from the left of square 6 to the right of square 5 along the contour of the throat. This is based on the perfectly proper assumption that the frame will be braced adequately against buckling on the compression side and that a cross member of relatively great stiffness will be connected between the two side frames of the machine at *P'*, Fig. 1.

Nature of Load Is Shown

Fig. 4 shows the specimen under a relatively great load *P* to show qualitatively the nature of the deformation under load. (The load in this case is considerably above the value at which the frame would buckle if it were not braced). The actual readings were taken at relatively light loads for reasons which will appear presently. The accompanying table, page 23, shows the data taken by actual measurement with a steel scale and an eight-power magnifying glass. Fig. 5 shows this data plotted so that the degree of stress concentration in terms of reaction *P* is shown. Thus, for a reaction of one pound at *P* there will be a stress concentration of 22 pounds per square inch at the point of maximum stress in the throat. With this information the designer can proceed with the work of changing the design to use material and weld metal most advantageously to strike the best possible cost balance.

It will be observed in Fig. 5 that the value of the maximum stress with reference to reaction *P* falls off as *P* increases. This, of course, would happen in the same way in steel but to a negligible degree for any strain below the yield point. For practical purposes we may consider steel worked below the yield point as a material of infinite stiffness so far as stress distribution is concerned. At light loads the curve for rubber coincides with the curve for steel. The softness of rubber (Young's modulus 600) is the important advantage in connection with its use for this purpose. Deformations may be obtained which are directly measurable with a magnifying glass. Prolongation of the curve obtained in this manner permits an accurate determination of the amount of stress concentration in a steel model.

In the case under investigation, if we are to work the steel at 10,000 pounds per square inch, the permissible reaction at *P* is 450 pounds (assuming that adequate provision for buckling is made). It is obvious that such a design would be uneconomical from any point of view. However, the scale model has furnished the designer with the information necessary to make a redistribution of the material in the interest of cost economy.

Kettering Views Research and Invention

CHARLES F. KETTERING
Co-author of "The New Necessity"

MENTOR to the entire manufacturing world insofar as quantity production is concerned; a tonic to the builders of machinery . . . that's the automobile! The story giving the highlights of its amazing development is colorfully and convincingly told by Charles F. Kettering and Allen Orth in their recently published book, *"The New Necessity."* The former personality needs no introduction to engineers; Mr. Orth is connected with General Motors research laboratories.

These hundred odd pages showing what the automobile has done for modern civilization should go down in engineering records as a worthy historical document. While the central theme is the automobile the data goes further afield, revealing how all industry has been influenced by its development. The early part of the volume is retrospective. Rising from a horseless carriage that incited skepticism and ridicule to industry's unequaled consumer of raw materials and a veritable "necessity," the automobile is shown as having a tempestuous record.

Considering this comparatively recent factor as an engineering achievement, it has no precedent. Particularly significant is the volume because of the authors' qualifications to write authoritatively on the automobile. Readers are given the picture just as it looked in the days of the pioneers. The early struggles for mechanical perfection are inspiring and even today when improvement has reached a high level, if automotive engineers will employ the same tenacity that characterized those trail blazers in coping with their problems, the industry has only scratched the surface of its possibilities.

One would not expect Dr. Kettering to collaborate on a book without saying something about inventing. He is one of the outstanding exponents in the realm of inventions and has contributed immensely to the automobile's present refinement. The chapter on "This Business of Inventing" is particularly worthwhile reading and when the reader has finished he has learned something from one who has had vast experience. The purpose of the discussion is not to discourage inventors and inventions but rather to point out what the individual with a "new idea" must expect in transforming it from a figment of the imagination to a commercially successful product.

Research and its significance to industry has a prominent place in the book. Its application denotes progress. The way in which this subject is handled makes it particularly readable. While not a highly technical discussion such terse statements as this make it outstanding: "A research problem is not solved with apparatus; it is solved in a man's head. No one ever solved anything in a research laboratory. The laboratory is the means by which it is possible to do the solving, after the man has the idea clarified in mind." This is characteristic of Dr. Kettering's manner of illustrating his points.

The new book was written as one of a series dedicated to the Century of Progress. It was not intended to cover the record of the automobile completely, but rather to give an insight into certain phases of development that might have escaped the attention of a busy people. Publishers are Williams & Wilkins Co., Baltimore, and it may be obtained through MACHINE DESIGN for $1.00 plus postage.

Compact Drive Units Improve Appearance, Cut Costs

By Allen F. Clark
Editorial Representative, Machine Design

Fig. 1—Angular position of shaft on drive unit makes neat machine possible

REDUCE costs!" Every designer has been confronted with just such an ultimatum, and all have worked with the specter of old man economy balefully watching over their shoulders. With cost reduction an absolute necessity, it is little wonder that the use of motors and speed reducers in integral units has become one of the most widely employed innovations in design of machinery. This becomes particularly apparent when other advantages of these drives, in addition to saving of first cost and assembly cost, such as greater compactness, cleaner machine lines and savings on adjacent parts are realized.

Sufficient to say of these drives that they are a motor and reducer or increaser combined. Further definition would be superfluous as nearly every type of motor can be and has been joined with a great many types of reduction units. Classifications include vertical, horizontal and right angle types, or a speed reducer or increaser on each end of the motor, governed motors, universal motors, multi-speed motors and even an explosion resisting unit approved by the Underwriter's Laboratories. In addition, the power take-off may be in a number of different positions and two or three shafts may be taken off, each with a different speed.

These new units affect design in a number of phases outside of the cost angle. One of the major points which must be considered is that quite often the new drives are specified more closely than the separate motor and reducer. That is, they have been engineered in many cases for specific types of applications and will not stand overload in others to the same degree as would previous designs. Their method of specification requires a more exact knowledge of just what the machine will be called upon to do and how much overload may be anticipated.

One manufacturer in taking this accuracy of purpose into account recommends that the following factors be considered when designing the drive for conditions other than steady load continuous duty:

For severe shock drive—Divide safe horsepower by two

For light, intermittent service—Multiply safe horsepower by 1¼ to 1¾

For intermittent shock drive—Use safe horsepower as calculated

Another point where the design should be

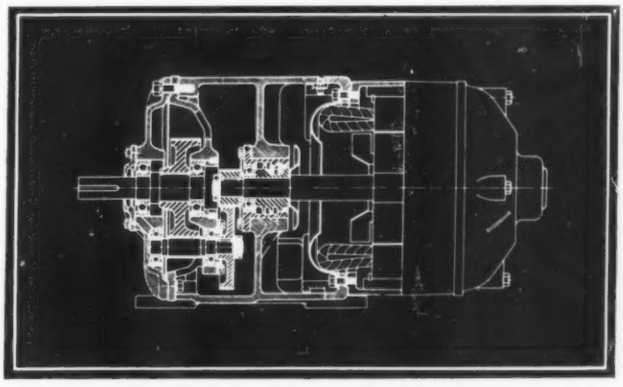


Fig. 2—Cross section of typical unit composed of motor and speed reducer in one case

Fig. 3 — (Above) — Portable power shear is made possible by using integral unit for the entire power drive. Fig. 6— (Right)—Cleanliness of units permits their use on machines such as those employed in candy making

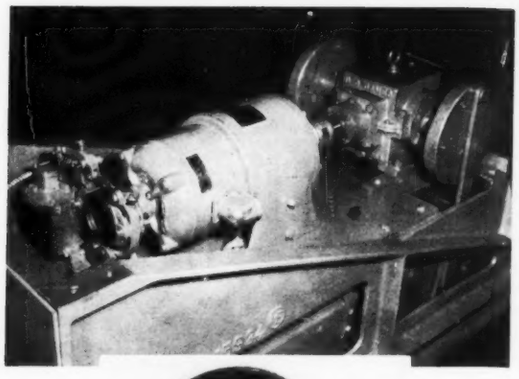
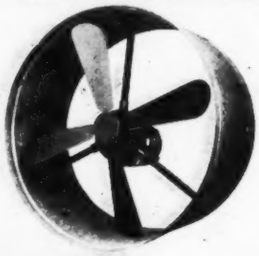


Fig. 4 — (Above)— Drive unit design permits the use of brake to prevent rotation of unit when conveyor it controls is in any given position



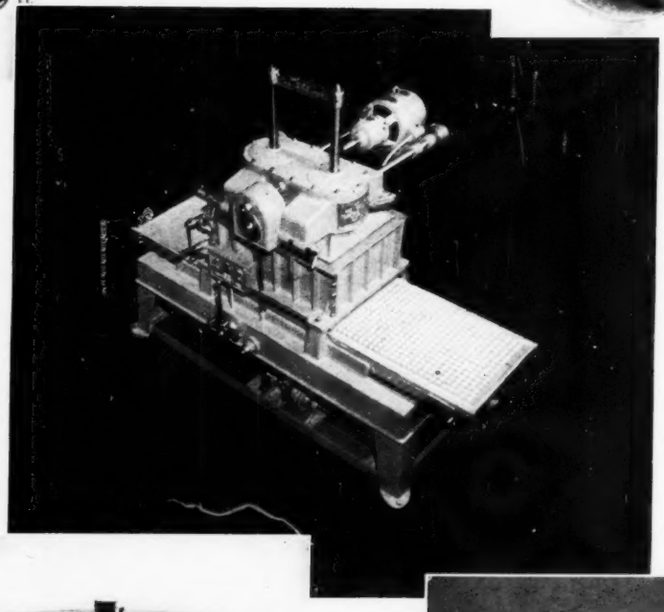
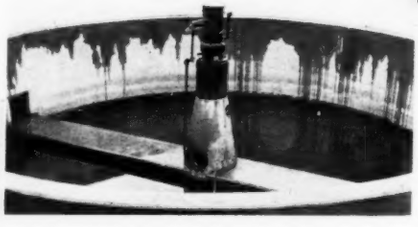
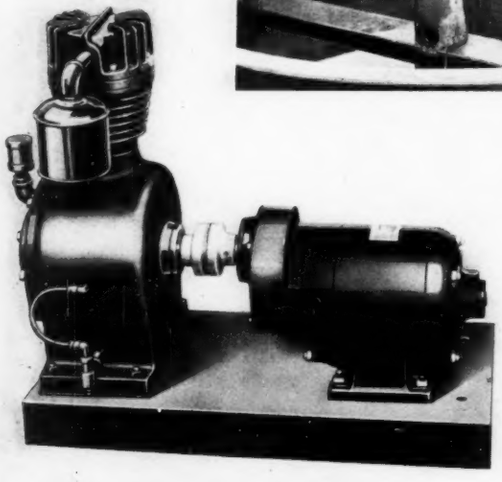


Fig. 5 — (Above) —Spider supports for the entire assembly are carried on the gear case. Fig. 9— (Below) — Space in which these two drive units are mounted would be far too small for two slow-speed motors of same speed

Fig. 7 — (Right) — Unit may be mounted directly on vertical shaft for use with sludge arm. Ratio in this case is 6400 to 1





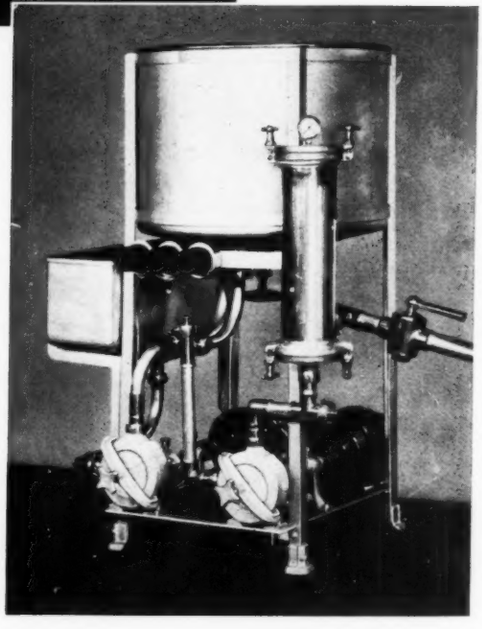


Fig. 8—(Left) Compactness secured in compressor drive. Previous drive occupied 1.6 more area

checked to insure safe operation is in consideration of the torque imposed on the output shaft. It is known that these new drives can be obtained with speeds ranging from 1 revolution per hour to 10,000 per minute and with ratios of infinite variety. Yet a combination of ratio, speed and horsepower may be obtained which will induce failure regardless of factors such as the material used in its construction. A safe computation of the maximum torque in inch pounds which will be produced at the output shaft can be obtained by use of the drive factors given in the foregoing and the following formula:

$$Torque = \frac{63025 \times HP\ of\ Motor \times Efficiency\ \%}{R.P.M.\ of\ drive\ shaft}$$

The compactness of these drives is essential in many installations as shown by the accompanying photographs of applications, many of which could not be accomplished with the same neatness without a unit drive. Saving in space of an integral drive unit over a large slow speed motor is visualized easily. In considering compactness, it would be well to realize that the different types of reduction units naturally vary as to their proportions. Double and triple reductions will increase size, while the use of a special steel for gears and shafts will permit even greater compactness.

Saving in cost is another reason for widespread adoption of these drives. Economies effected by their application are afforded primarily by the use of small high speed motors which are lower in first cost than the bulkier slow speed models sometimes used. The reduction unit may be added to a high speed motor and the total cost still be less than previous totals. The prices shown in the following will give an estimate of the possible savings. These figures, of course, will vary with the manufacturer, but they are indicative of what can be accomplished.

2 HP, 360 RPM, squirrel cage motor		$218.00
2 HP, 1800 RPM, squirrel cage motor	$50.00	
Speed reducer, ratio 5.5:1 with 360 RPM output	25.00	
Total cost of drive		$ 75.00

Thus the total saving is $143.00 or a reduction of about 66 per cent from the cost of the slow speed motor. Changes in ratio and in type of reducer will vary the possible saving.

A smaller but still appreciable saving can be shown by comparing the cost of a separate motor and reducer mounted on a bed plate, direct connected by a flexible coupling, and giving the same output speed as the integral unit, with the cost of the latter.

2 HP, 1800 RPM, squirrel cage motor	$ 50.00
Flexible coupling	10.00
Mounting plate	18.00
Separate speed reducer	35.00
Total	$113.00

Here the saving by use of the integral unit is $38.00, a reduction of 33 per cent. In general, considering all factors such as reduction of parts required for the frame of the units, end bells, etc., about 30 per cent reduction can be saved in cost of the drive unit over the separate motor and reducer. There may be some variation in the figures given in the foregoing tabulation, particularly with reference to the flexible coupling and bed plate, but the costs given are about the minimum to be expected. Even when the new drives must be mounted on a bed plate in applications such as that shown in Fig. 8, the cost of this bed plate may be reduced as the integral unit requires much less space than two

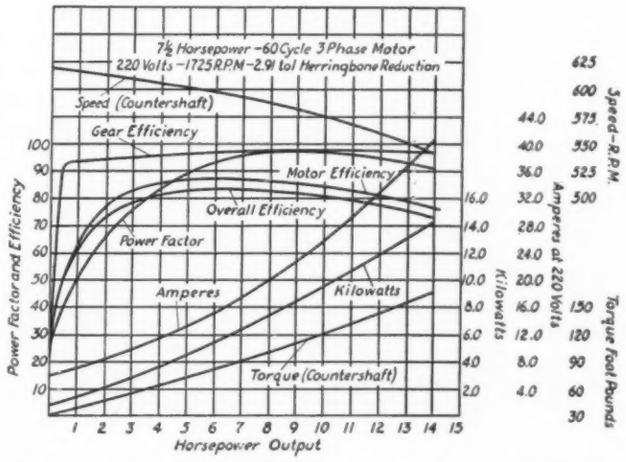


Fig. 10—Typical performance curves of drive composed of motor and speed reducer in one case

separate units or than a large slow speed motor.

The small size of the units also permits mounting directly at the point where the power is required, Figs. 1 and 3, or in parts of the machine where space is limited, Fig. 9. This is of extreme advantage to the designer inasmuch as he not only can simplify and improve the lines of his machine from an appearance standpoint, but also can eliminate parts which would be necessary to transmit the power to the machine drive shaft should the reduction unit be placed at some remote point.

In mounting, a flexible coupling should be used between the countershaft of the unit and the drive shaft of the machine. In some applications, such as the one shown in Fig. 5, where the operating portion of the machine is mounted directly on the shaft of the drive unit and no shock loads are transmitted, this coupling may be eliminated. Outboard bearings are recommended for applications where severe overhung loads are exerted. In such applications, if unusual conditions make an outboard bearing impractical, the drive can be provided with a supporting bracket which will answer the purpose.

Elimination of open gearing and other exposed moving parts also introduces a safety

factor that is well worth considering. Not only is enclosed gearing safer, but its lubrication can be controlled, thus insuring lower ultimate costs by reducing wear, and providing quiet operation. However, it is well for the designer to bear in mind that the life of the unit is dependent upon the efficiency with which the grease is kept from the motor windings. The manufacturers of the units have taken considerable care with the seals used to accomplish this purpose. Care taken to insure mounting so that these seals will carry out their normal function will repay itself by producing a better, more permanent design.

The universal acceptance of these unit drives in the dairy and food industries is confirmation of the fact that they will not distribute grease to other portions of the machine on which they are mounted or on the material being handled by the machine.

Forge Reveals Ancient Design

REMAINS of 193-year old Sand's Forge at left. Below is the interior showing the trip-hammer arrangement and wooden gearing for operating auxiliary shaft

STRIKING is the contrast between our modern alloy steel driving mechanisms and the wooden gearing employed nearly two centuries ago in Sand's forge, built in 1740 near Birdsboro, Pa. Early settlers operated the forge to produce wrought iron wagon tires, scythe blades, and wrought nails. Power was obtained by damming the water and sluicing it to a 10-foot water wheel.

The paddle type wheel was attached to a one-piece mainshaft, 14 inches in diameter and hewn from a single tree log. On the shaft was a drum into which were inserted at spaced intervals projecting iron pegs. Contact of these pegs against similar iron projections at one end of a 12-foot counterbalanced beam provided the action of a trip hammer.

Mounted on the same mainshaft and next to the inner bearing was an all oak 5-foot gear, the teeth of which were doweled in place. This gear in turn drove a small pinion comprising two wooden disks set 8 inches apart and toothed with oak rungs to mesh with the gear. The pinion was mounted on a secondary shaft which extended through opposite sides of the building with an overhang of two feet.

The contrast between this forge shop, and present-day contruction bespeaks man's desire to progress, in spite of the unwarranted premonitions of individuals and groups such as the "Technocrats." Imagine trying to meet present-day needs with the type of equipment illustrated!

Fig. 1—Steel stampings may be employed for wheels to be used with tires of smaller diameters

Automotive Trends Show Incessant Activity

By Austin M. Wolf

PRESENT economic conditions have had no depressing influence during the past year on the accomplishments of the engineering departments of the various automobile manufacturers. In this field, as in the case of other types of machinery, the designer has been called on to introduce new ideas, economies from both engineering and production standpoints, and other features showing a more comprehensive study of design than in any previous year.

With its smaller pocketbook, the public naturally has shown a preference for the low-priced cars and it has become necessary for the manufacturers to endow them with performance characteristics heretofore only associated with larger cars. There is a keen desire exhibited by the manufacturers to build vehicles which will withstand a mileage in excess of 25,000 without the need of other than normal servicing. This fact and the greater ease of control are the outstanding results.

The various mechanical arts already owe a debt of gratitude to the automotive industry, and again it is leading the way to some significant future developments in which alloyed cast iron will replace drop forgings. There have been rumors of cast iron camshafts and crankshafts which have been looked upon as chimerical. The

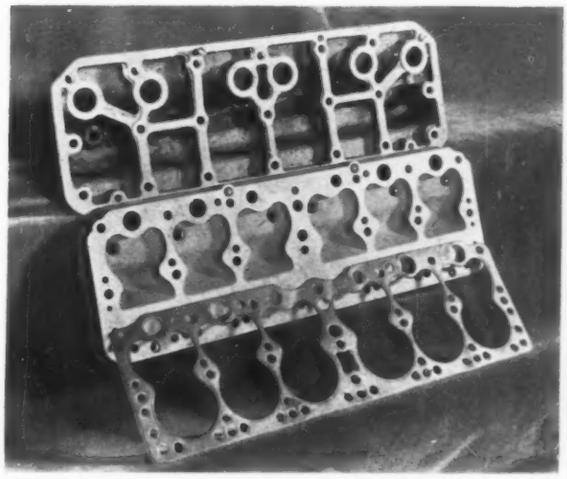


Fig. 2—Two-piece design of head, using different materials, allows certain manufacturing advantages

Hudson "Terraplane" now is provided with a camshaft made of a cast iron alloy containing nickel, chromium and molybdenum and processed in an electric furnace. In the elimination of dies, heat treating and plating equipment, fuel and operating charges, the drop forging art is being threatened in certain fields. The alloy shows little grain growth and the originally planned bearing clearances will not be absorbed by later expansion of the material. The subject of grain growth has been studied intensively by the Waukesha Motor Co. which has developed a cylinder iron alloy having an extremely dense structure, a low rate of "growth," a tensile

strength of 60,000 pounds per square inch and a brinnel hardness between 280 and 300.

Exhaust valve inserts are becoming more popular and are used to combat the problem of valve sinking and frequent regrinding where the usual type of cylinder iron is used. Tungsten-chrome-nickel alloy, ni-resist, stellite facing and high speed steel are being used. With the hard materials the valve seat is ground after it is placed in the cylinder block to secure concentricity of the seat and the stem.

The ability of aluminum to conduct heat rapidly and thereby prevent local hot spots, makes it a desirable material for engine combustion chambers, allowing the use of higher compression ratios. While some engines are built with an aluminum head, a two-piece design allows certain manufacturing advantages. The combustion chamber side can be made as a permanent mold casting to insure a denser metal and more uniform volume in the combustion

Fig. 3—Connecting rods on new Pontiac are balanced for center of gravity

chambers without the need of contouring. The upper half is an ordinary gray iron casting which acts as a water jacket. A construction of this type is shown in Fig. 2.

Bronze washers formerly have been used in differential gears in order to absorb wear in a replaceable member, saving the gears and case from damage. Hudson now is introducing bakelite washers at this point.

With the prevalent smaller tire diameters and the use of the drop center rim, a comparatively short spoke is necessary between the latter and the hub portion of the wheel. Motor Wheel Corp. has developed the artillery type steel-spoke wheel shown in Fig. 1. The "spider" is drawn from a narrow strip of metal with a small percentage of waste material. It is interesting to consider how various processes can be adapted to changing conditions, of which this wheel is a notable example.

In the building of engines, great stress has been laid upon the slight weight deviation in the various piston, wristpin and connecting rod assemblies of the different cylinders. With increase in engine speeds approaching 4,000 revolutions per minute the proper balancing of the reciprocating masses is increasingly essential in view of the inertia forces involved. A new trend is the maintenance of the various units to within extremely close weight limits which automatically insures that the assembly will be within the desired amount. In the production of the new Pontiac engine there has been placed a production limit plus or minus 1/16-ounce on the rods and pistons. A further feature is that the rods are balanced for center of gravity. It will be noted in Fig. 3 that there is a boss at the bottom of the bearing cap which with the boss at the upper side of the big end provides machining surfaces to obtain the necessary balance. By this method the resultant forces on the crankshaft pins will be practically alike and when making a replacement in the field the balance of the various assemblies is preserved.

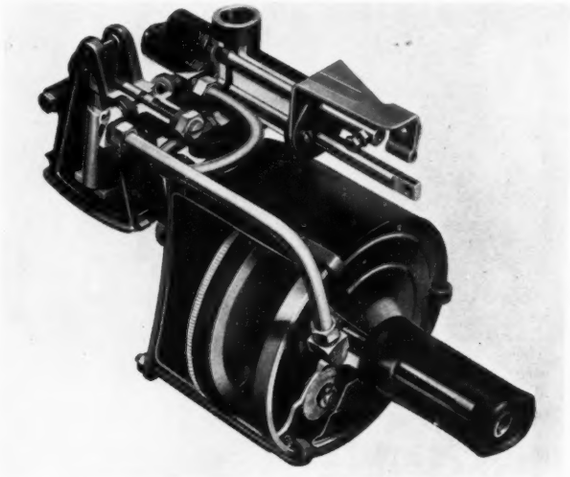


Fig. 4—Control valve is mounted as a unit on operating cylinder in automatic clutch

Clutch Has Control Valve

The automatic clutch control now is usually provided with the control valve mounted as a unit on the operating cylinder. A cushion control valve has been added, consisting of a pendulum, Fig. 4, that swings parallel to the line of motion of the car and as it passes on either side of its normal position, operates a small cut-off valve in the bleeder line from the operating cylinder, smoothing out clutch engagement by preventing jerking on sudden acceleration.

Pierce-Arrow has introduced the hydraulic

valve lifter shown in Fig. 7. Within each tappet lies a well fitted plunger, and oil from the pressure lubricating system is introduced between the two members, spreading them apart and thereby making zero clearance between the cam and the bottom of the valve stem. The base of the plunger contains a ball check valve which traps the oil within. Some oil escapes with each valve lifting but when it again seats and the load is absent, engine oil pressure aided by a light spring under the plunger brings about a refilling of the lifter.

Fig. 5—Universal joint design incorporates long rollers of small diameter as bearings

Heretofore all helical gears have been positioned axially. The Dodge transmission, Fig 9, incorporates a sliding helical gear to engage the reverse idler or the low speed countershaft gear. It will be noted that all the gears are of the helical type. In order to counteract the tendency of the gear to creep, the mainshaft is provided with helical splines which neutralize it. Shifter rods in this transmission are made from bar stock and the shifting yokes are projection-welded thereto.

Recently the European idea of using rollers having a small diameter in comparison to their length and without the use of a cage, became more firmly established in this country. The use of needle bearings for journals having an oscillating movement has found a receptive field in universal joints, the Spicer joint shown in Fig. 5 being a typical example. The need of frequent lubrication is eliminated and joints can work under greater angularities without destructive wear. The Gemmer Mfg. Co. uses an extremely long roller on the cross shaft of its steering gears, extending the full length. Needle bearings also have been extended to countershafts and reverse gear idlers in transmissions to replace the previously used bronze bushing. In these instances, however, the diameter is somewhat greater than the normal conception of a needle bearing.

Adopts Power Brake

The Stewart-Warner power brake has been adopted by Pierce-Arrow. It will be recalled that a threaded sleeve moves axially when retarded by a brake disk controlled through the foot pedal. Since its shaft is in the power transmission line to the rear axle, the movement of the threaded sleeve is dependent upon the speed of rotation of the shaft and the pressure on the pedal. Movement of the sleeve is conveyed to the braking mechanism and the apparatus constitutes a servo mechanism. Due to the small movement and light pressure required, the brake pedal resembles an accelerator treadle.

Fig. 6—(Above)—Eye focus is concentrated on one spot in new dial arrangement. Fig. 7— (Right) —Hydraulically controlled valves can be governed accurately

Outstanding among control features on some of the new cars is the elimination of the starter button in combining its function with the accelerator pedal. The accelerator pedal is interconnected with the starting gear mechanism so that, with a dead engine, the gear is engaged

when the pedal is depressed and at the same time the throttle is disconnected from the pedal. As soon as the engine picks up, the starting gear is disengaged in the usual fashion and suction in the intake manifold acts on a diaphragm which withdraws the starter connection and re-establishes the throttle control with the accelerator. This mechanism is used on the Chevrolet, DeSoto, the Chrysler Six and Eight. The DeSoto control is depicted in Fig. 8.

In the Buick and Pontiac, a push button at the left side of the instrument board energizes a solenoid above the starting motor shell and

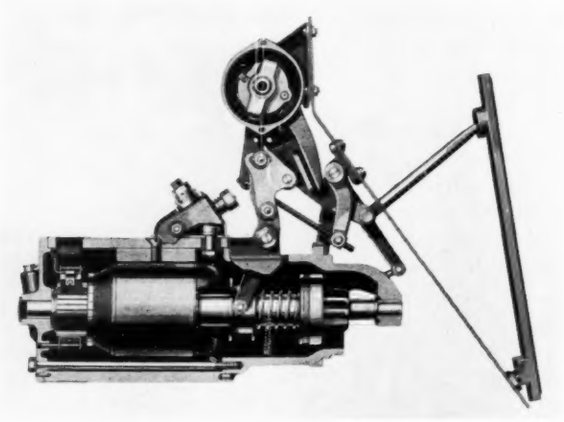


Fig. 8—Accelerator pedal is interconnected with starting gear mechanism to eliminate button

slides the starting pinion into engagement with the flywheel ring gear.

The gasoline engine is capable of giving remarkable performance under ideal conditions such as prevail in the engine test room. Engineers have striven to duplicate ideal conditions so that the engine will be freed from abuse or misadjustment due to the personal equation. In view of this phase of engine operation as well as other chassis parts, the automobile of today is replete with automatic controls. These can be divided under three classifications, namely: thermal, vacuum and inertia.

Automatic thermal controls take in the heating of the inlet manifold hot spot, the automatic carburetor choke, and in combination therewith a linkage control between the thermostat and the throttle, causing the engine to idle faster when cold than when warm. Numerous shock absorbers employ a thermostatic control over the effectual orifice by-pass, to compensate for the increased viscosity of the liquid when cold.

Foremost of the automatic vacuum controls is the accelerator-starter previously described. The vacuum is used by several ignition manufacturers to provide an auxiliary means of advancing or retarding the spark in combination with the centrifugal timing control. Automatic inertia controls are exemplified by the pendulum cushion valve shown in Fig. 4 and the new Delco shock absorber. Within each shock absorber of this type is a weighted valve, held open by a sensitive spring. So long as the valve stands open, the shock absorber is released and allows free movement of the springs. An upward thrust of the chassis, conveyed to the shock absorber, instantly closes the inertia control valve and the full resistance of the shock absorber opposes a rebound of the springs.

The reading of the various dials or gages is an important phase in car control and there is a decided trend to unify the various instruments under one glass, compactly arranged so as to concentrate the eye focus to one spot. In the Graham instrument panel in Fig. 6, the ammeter, water temperature, oil pressure and gasoline gages are included within the large dial of the speedometer, the indicating hand of which is chromium plated. The instrument panel is made of translucent glass, giving a new and novel effect when lighted.

The most noteworthy accomplishment in body design has been the provision of adequate ventilating means. In the Fisher "No-draft" ventilating system the forward sections of the front and rear quarter windows pivot so that they can be swung outwardly. When the deflector is swung out, a vacuum is induced within the body while a small amount of air enters through the

Fig. 9—Helical spines neutralize tendency of the gear to creep along shaft

forward opening. The deflector is under the control of an inside lever through a worm mechanism. The rear window sections of the front doors slide up and down as heretofore while in the rear quarter windows they are fixed. In this manner individual ventilation can be obtained at any one or all of the four points, eliminating the through draft that has been characteristic of the ordinary closed car.

From the descriptions given of the new developments, it will be seen that the designing engineer has been extremely active over the past twelve months. The results are all the more noteworthy when it is considered that the new cars not only have remarkably greater performance characteristics, but that their prices are lower than they have been in the past. This is indicative of a close liasion between the designing and production departments.

Selecting Progressive Sizes

MANY manufacturers maintain an engineer or a department for that highly important function of standardizing the dimensions of elements of tools and products, while committees and bureaus are engaged in the same work for the engineering societies and for the government, yet there still is a great deal to be done along this line. An example of what can be done in the way of developing standard proportions for like members in a progressive series of machine sizes or capacities was indicated in the article on Crankshaft Design in MACHINE DESIGN for December, 1930.

The example in that instance was a part requiring extensive mathematical investigation. In many other cases the parts to be proportioned either do not require or are not amenable to exact analysis, although they may be developed by a graphical solution. Relative dimensions of such parts usually are gaged by eye and tabulated.

However, the best of taste or vision is liable to err, and in the line-up of sizes selected by this method there may be some misbegotten ones. Such discrepancies have caused certain units in a size series of similar products to remain on the shelves for no better reason than that they were outshone by sister units. Regardless of whether irregularities between sizes influence manufacturing and sales or not, no designer really wishes to build any more unsystematic standards such as our pipe sizes and our wire and screw gages. Yet there is danger of doing just this as the following example will indicate.

A certain engineering body tabulated and submitted for approval of manufacturers a dozen sizes of a specialty. Seven dimensions of each size were subject to the proposed detail standardization. A manufacturer submitted the tables to his standardization engineers who reported that the progressions were irregular and offered a substitute table. To decide this a referee, called from another branch of the engineering department, plotted the tables on cross section paper and he learned to his great astonishment that the use of the word progression by both parties was admirable although used strictly rhetorically.

Four dimensions of the subject as chosen are plotted in Fig. 1. Approximate, although not weighted, means were drawn through each group as indicated by the dotted and chain lines. Formulas for these straight line functions were derived and listed on the charts with their easily deduced constants.

As use of these formulas sometimes results in decimal dimensions it was pointed out that limit lines drawn 1/16 or 1/8 inch each side of the curves might be employed to limit the errors in progression necessary to the strict use of fractional sizes. This practice is indicated in Fig. 2, on which for example dimension $P = 7/8$ is required with base or nominal diameter 3⅜ to 4 inches.

In any design practice involving a number of unit sizes or capacities this general practice is prolific in good results even when standardization for public use is not contemplated. It may be extended to exponential curves drawn on logarithmic or semilogarithmic paper where rational analysis is possible. It speeds drafting greatly and impresses the balanced proportions desired as much by engineers as by architects.

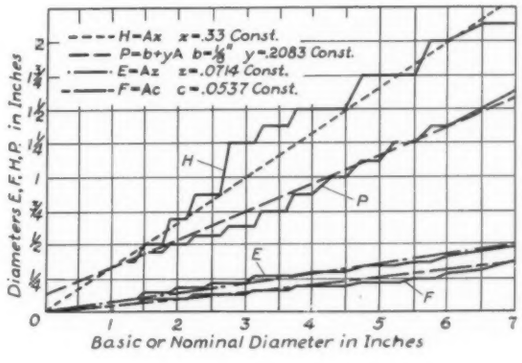
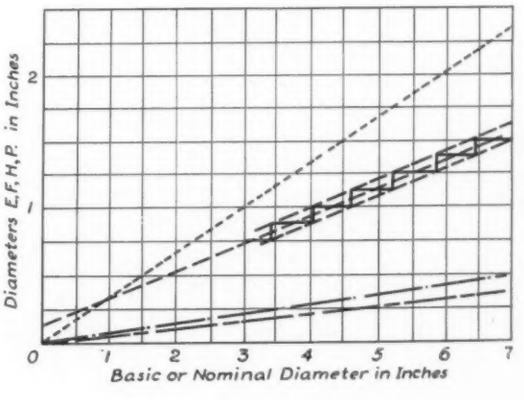


Fig. 1—Analization of the proposed sizes in a progression revealed considerable discrepancy. Fig. 2—(Below)—Revised proportions conform closely to standardized limits for dimensions



MACHINE DESIGN

Editorial

Credit the Technocrats for Stimulating Interest in Design!

THE furor created by "Technocracy" is a curious commentary on the topsy-turvey period through which the world is passing. At intervals since 1820 economists and others have called attention to the increasing necessity of co-ordinating social progress with the advance of science. These warnings, sometimes emanating from competent authority, seldom attracted more than cursory attention. Howard Scott and his self-styled "Technocrats" have taken the same century-old basic idea, added to it a theory of "energy determinants," wrapped it in a new package with a catchy label and, with a threat and promise, have hurled it at the heads of a troubled people.

Perhaps the success of "Technocracy" in winning a hearing is due partly to the temper of the people and partly to the threat and promise which accompanied its introduction. The statement of a technocratic enthusiast that "we are faced with the threat of national bankruptcy and perhaps general chaos within 18 months" certainly is calculated to arrest thought. Equally astounding is the promise that 660 hours of work per year per individual aged 25 to 45 will produce a standard of living for the entire population 10 times above the average of 1929.

We may resent the tone of finality with which "Technocrats" utter unproved statements; smile at the exaggerations in their statistics and condemn their utter recklessness in dealing with a serious problem, but at the same time we must credit them with having stirred up discussion by more competent authorities than they which eventually will acquaint the public with the real truth about machines and the machine age. The resultant exhaustive study by others than "Technocrats" is bound in the long run to react favorably to the interests of machinery and machine designers.

Stresses in Machine Parts

SERIOUS consideration is being directed to the development and extension of methods for investigation of stresses in machine details. During the coming year there probably will be developed a medium-priced photoelastic polariscope by means of which not only visual but photographic analyses can be made. Such equipment has been available in the past, but at relatively prohibitive cost.

Elsewhere in this issue is published an article covering a method which simulates photoelastic testing. Attention is drawn in this contribution to several other processes, each of which has its place. Through establishment of these various methods definite progress is being made toward provision of readily applicable means whereby dangerous stress concentrations can be reduced or in some cases eliminated entirely.

John Ericsson

Master Designers

John Ericsson

DURING the first half of the nineteenth century, invention was more nearly a group process than the creation of any one man. There were scores of men working on numerous developments, each an essential step in the final design. Many inventions were brought to a successful conclusion only by application of principles evolved by men whose names generally are not connected with the device. John Ericsson, the greatest engineer Europe ever bestowed on America, was once the foremost of these contributing designers.

ERICSSON'S work was done principally in the fields of steam engine design, caloric engines, armored ships and steamships. Although he was granted many patents his achievements cannot be estimated accurately as he often neglected to protect his rights. His steam engine and steamship improvements include the first successful surface condenser, the screw propeller, the first direct-acting engine, the power fan-blower system and many other developments.

A STEAM turbine devised by Ericsson failed because of lack of proper materials. His locomotive, entered in competition with that of Stephenson, was considered the better design of the two. It was the faster, but broke down in the tests because of faulty construction. This designer of the MONITOR, the most able ironclad of the time, also built the first steam fire engine, developed a practical sounding gage, fluid meters, sun motors, army ordnance, hydrostatic weighing machines and other practical devices.

SWEDEN, where he was born in 1803, held his love and devotion throughout his 86 years, even though he was a naturalized citizen of the United States and did a great deal of work in England. He did not allow monetary considerations to deter him from devoting his best efforts to the improvement in the domestic and military marine of his adopted country; many of his most valuable designs were never paid for or even credited to him. Unbending will, great physical power and tireless energy enabled him to produce these and other designs which earned the commendation of the world.

PROFESSIONAL VIEWPOINTS

Publication of letters does not necessarily imply that MACHINE DESIGN *supports the views expressed*

Comments and Questions from Our Readers. Machine Design Will Pay for Letters or Solutions to Problems Suitable for Publication

Create Bushing Standards!

To the Editor:

THE discussion in the December issue by A. J. Stock on the desirability of standardizing bushings is quite interesting, and insofar as reference is made therein to the work of the American Standards association (ASA), a few suggestions may be helpful. One of the functions of the ASA is to bring the industrial groups interested in a specific problem of standardization around the table so that they may work out a solution acceptable to all. In so doing the ASA leaves the technical decisions to the groups in question.

The ASA therefore could give consideration to a request for standardization of bushings coming from some industrial organization or group such as a technical society, a trade association, or some other large organization, or again, a group of manufacturers or users of the product concerned, even though they are not organized in a trade association.

In the present case it would appear that the ASA could be approached in several ways with a request to have the standardization of bushings taken up under its auspices. It is not the place here to make suggestions in this respect, the purpose of these comments being merely to indicate the manner in which the subject might be brought before the ASA. In fact it occurs sometimes that a standardization problem on the desirability of which all groups seem to agree is not submitted for consideration to the ASA simply because none of the groups is acquainted with the manner in which this should be done. The matter then may be postponed and perhaps forgotten on account of pressure of more urgent business.

It may be stated here for those not yet acquainted with the ASA that this body is a judicial one taking no stand one way or the other in the technical questions dealt with in its committees. Its only purpose is to bring the groups together and to see that the American standard resulting from their co-operation is developed through adequate representation of those having an essential interest in the matter. If the manufacturers or the users of bushings wish to get in touch with the ASA in order to discuss in a preliminary and noncommittal way the method that might be followed in initiating a project on the standardization of bushings, the ASA will lend its assistance gladly.

—JOHN GAILLARD, ASA,
New York.

Eliminating Drawing Confusion

To the Editor:

THE interesting system for keeping track of drawings outlined by W. S. Brown in the December issue follows the popular check out plan used by tool rooms, bath houses and large hotels. However, in many places where space does not allow for wall racks some other scheme must be employed. A plan successfully in use consists of adopting standard commercial "Out" cards, shown herewith, as requisitions for the issue of drawings from the files.

OUT

TAKEN BY	NUMBER, SUBDIVISION OR NAME	DATE	TAKEN BY	NUMBER, SUB

Section of "Out" card used successfully for keeping track of drawings removed from file

The procedure is as follows: The designer secures an "Out" card form, and writes in the first available space the number of the drawing wanted, the date and his signature. The card is presented to the file clerk as his authority for removing the drawing wanted. The clerk removes the tracing, substitutes the card in file and delivers the drawing to the signer of the card. The card thus becomes a permanent record of the remover of the drawing and his only responsibility is to return it to the unfiled basket, or if the drawing is transferred, have

new cards given to the file clerk. The clerk removes the card when refiling the drawing and the card is ready for use again.

Obviously, only one drawing at a time can be requisitioned with a single card. Therefore, when a designer requires a list of drawings he simply sends the list to the file clerk who executes the cards. Under no circumstances should anyone other than the clerks remove drawings from the files, as such action voids the clerk's responsibility for the care of the drawings. Drawing files should be protected more securely against unauthorized removal than against fire because there is no insurance on losses by removal.

Files which are accompanied by a card index offer an opportunity to apply Mr. Brown's plan easily without the expense of wall racks as it is only necessary to use numerical clips, or file signals, which the clerk attaches to the cards according to the number or color assigned to the designer and removes same when refiling. This system is slower than "Out" card method although it reduces handling of drawings.

The "Out" card plan is preferable because it is simple, inexpensive and fixes responsibility. The records are locked up with the drawings and thus are permanent and tamper proof.

—M. W. ELMENDORF,
Rochester, N. Y.

Thomas A. Edison—Master Designer

To the Editor:

WE HAVE received our copy of the December issue which contains the article "Master Designers—Thomas A. Edison." In the interest of accuracy, may we call your attention to the inclusion of Dictaphone in the list of mechanisms and processes designed or improved by Thomas A. Edison. There are two types of dictating machines—the Dictaphone and the Ediphone, and it is the Ediphone, I am sure, that you intended to include in this list.

The Dictaphone was the outgrowth of the work of the Volta laboratory in Washington and can be credited principally to Charles Sumner Taintor and his associates, Alexander Graham Bell and Chichester Bell. On the other hand, the Ediphone was developed by Thomas A. Edison and was his contribution to the design of a dictating machine.

This comment is offered in the friendliest spirit with no desire to belittle the accomplishments of Mr. Edison.

—RICHARD T. HARRIS,
New York

Editor's Note—Interesting comments such as those of Mr. Harris are sincerely appreciated. Both the Ediphone and the Dictaphone were developed during the ten years immediately following the invention of the phonograph, 1877-1887.

Know Your Shop!

To the Editor:

YOUR recent article on this subject gives a most interesting digest of papers pertinent to design presented during the Metal congress at Buffalo and brings to mind the importance of this procedure. Too much stress cannot be laid on the necessity for the designer being thoroughly conversant with the shop that will manufacture the machine. No two shops are equipped alike, and therefore a drawing that may be ideal for one shop may be inappropriate for another. Every manager has his own ideas of what is the best type of machine and consequently when equipping a works he will install nearly all of that class. It is well that the designer should bear in mind the machines that are available and what finish can be expected from them when designing a part and fixing the limits.

It is not sufficient to know that the shop is equipped with a certain machine and make. It is necessary also to have some idea of its present condition so that a reasonable conception may be formed as to what limits can be held under ordinary working conditions.

Another point is to have some inkling of the class of operators, and whether they are skilled, semi or unskilled. A drawing that might be suitable for the former may be unadvisable for the latter, who require that which not only is simple but foolproof.

—SIDNEY BEAUJON,
Rahway, N. J.

Standardize Screw Terminology!

To the Editor:

STANDARDIZATION of screws as recommended by W. S. Brown in your October issue is a most pertinent question. It is impossible to be certain regarding the dimensions of heads and nuts for screws and bolts unless a detail drawing is sent along with each order. Even then the chances are that the supplier will reply that his standards do not correspond to the drawing and request the use of some substitute.

This can be a serious matter, especially when close tolerances are necessary in connection with a given design. It may happen that a lug is provided on a casting to prevent rotation of the bolt head. If it is not desirable to machine this lug, and the bolt head is larger or smaller than anticipated, additional expense is encountered and assembly time is added. A definite standard along these lines would be of material assistance to everyone concerned. It would also reduce inventories as many special items could be eliminated.

—CARL E. SCHIRMER,
Springfield, O.

TOPICS OF THE MONTH

A Digest of Recent Happenings of Direct Interest to the Design Profession

WHAT is this "Technocracy?" That question has been bothering a lot of people. So popular has been the topic that the newspapers and magazines have utilized it as a circulation builder. Wherever it is discussed people gather to hear the argument. But when the subject has been exhausted the conclusions arrived at are vague and meaningless. "Technocracy" then is just a name; and moreover, one which covers a condition that has prevailed ever since James Watt invented his steam engine.

More interesting than the doctrine it sets forth is this organization of "Technocrats." According to reports it has been engaged for the past 12 years in an energy survey of North America. The chief "Technocrat" is Howard Scott, around whom much discussion has centered, particularly regarding his record. Columbia university is cited as the headquarters of the organization, which utilizes a number of unemployed engineers, architects and draftsmen. Out of their research has come charts and statistics, the latter of questionable accuracy. It seems that the organization has a tendency to paint the picture of mechanization much too colorfully. In fact the leaders have been guilty of gross exaggeration.

In discussing machines this statement by Scott is typical: "It is because we have not taken thought of this influence that we in America find ourselves where we are today, with ruin staring us in the face." When his startling assertions first were given to the public it was spellbound; then engineers began to examine the record for themselves. The result was a concerted attack on the data as set forth by the "Technocrats." Latest developments embody a long discourse by Scott on the breaking down of the price system. Although the "Technocrats" are able to visualize a cause they fall down when when a cure is sought.

* * *

Cites Benefits of Industrial Standardization

STANDARDIZATION of industrial products through the co-operation of government and industry should be continued, Bancroft Gherardi, vice president of American Telephone & Telegraph Co., urged at the recent annual meeting of the American Standards association in New York. The association last year, he said, approved 43 new standards, including bolt and screw sizes, specifications for insulated wire, and technical phases of the motion picture industry.

* * *

Suggests Cure for Depression Causes

INDUSTRIAL concentration in the larger cities must be broken up and diffusion of the individual units into outlying territory is essential to the lasting return of prosperity. This statement by Harold V. Coes of the engineering concern of Ford, Bacon & Davis, New York, held the attention of the meeting of the American Society of Mechanical Engineers, at which he spoke. He believes there is a growing realization that cities can become too large for comfort, wellbeing and safe and efficient administration. Too, the advantages of such locations, he said, except for specialized industries, are more than offset by their disadvantages. To strengthen the country's economic position, and balance the population, industrial concentration should be dissolved speedily.

* * *

Power Show Reveals Confidence in Future

EXCEEDING expectations both in exhibits and attendance, the tenth national exposition of power and mechanical engineering drew nearly 100,000 engineers to Grand Central palace in New York recently. Three hundred manufacturers of machinery and equipment indicated their confidence in business recovery by displaying many improved lines and entirely new designs.

Compared with former years, there were fewer actual displays of large heavy equipment. An interesting exhibit was an illumination meter which employs a metal having a specially treated surface susceptible to light intensity that sets up an electromotive force varying with the light intensity which, in turn, is indicated on a scale. Shown also was a smoke recorder in which the density is recorded on a chart. Simultaneously signal lamps of different colors light, the color depending on the density.

Another development that attracted wide attention was a steam ejector water cooler employed for air conditioning railroad cars. Vacu-

(*Concluded on Page* 58)

MEN OF MACHINES

Personal Glimpses of Engineers, Designers, and Others Whose Activities Influence Design

PROCESS for electroplating tungsten from water solutions of the metal salt recently was patented by Dr. Colin G. Fink, professor of electrochemistry at Columbia university. This discovery, which characterizes his unique place in engineering, makes possible a metal which has unusual properties as a protective coating, producing a smooth, hard, coherent plating of tungsten, silvery white in color with a high luster.

It was in New Jersey in 1881 that Dr. Fink was born. Graduating from Columbia college in 1903, he spent the following four years in the Ostwald Research laboratories of the University of Leipzig, receiving his Ph. D. degree in 1907. After 10 years with General Electric and seven years with Guggenheim brothers he was invited to take charge of the division of electrochemistry at Columbia.

Recently the U. S. circuit court of appeals handed out the unanimous decision that Dr. Fink was sole owner of the basic chromium plating patent (M. D. Sept.). In addition he is the originator of the drawn tungsten filament employed in the tungsten incandescent lamp, and the copper-clad nickel steel leading-in wire used as a substitute for platinum in all lamps, radio tubes, mercury arc rectifiers, etc. Besides being secretary and editor of the Electrochemical society, Dr. Fink contributes widely to the technical press and holds membership in a number of scientific organizations.

MECHANICAL perfection of the Grace liner, SANTA ROSA, put into service recently, is due in a large measure to the technical ability of W. W. Smith, chief engineer of Federal Shipbuilding & Dry Dock Co., Kearney, N. J., builder of the craft. He assumed an important part in the development of the geared turbine type of machinery. Since as far back as 1910 Mr. Smith has been engaged in similar work, first as a lieutenant in the navy assigned to work on the design of geared turbines for the navy collier NEPTUNE.

The place and date of Mr. Smith's birth was Versailles, Ky., in 1882. After graduating from the United States naval academy, Annapolis, Md., in 1902, he spent 10 years in naval service, advancing from midshipman to lieutenant. From 1907 to 1909 he was chief engineer of the SALEM, one of the first of the navy's turbine scout cruisers.

Upon this country's entry into the World war in 1917, Mr. Smith became affiliated with the Federal Shipbuilding & Dry Dock Co. Since that time the company has built more than 100 ships. This outstanding marine engineer probably is best known to the shipbuilding industry for his contributions to advancement in design of machinery. He also is active, however, in marine association work and is on the technical committee of the American Bureau of Shipping and on American Marine standards committee.

IN HIS newly appointed capacity as a member of the board of directors of the American Standards association, representing the National Machine Tool Builders' association, Clayton R. Burt brings with him a wide and varied experience in manufacturing. He is president and general manager of Pratt & Whitney Co., Hartford, Conn. Industrial development as it affects machine design has been studied closely by Mr. Burt.

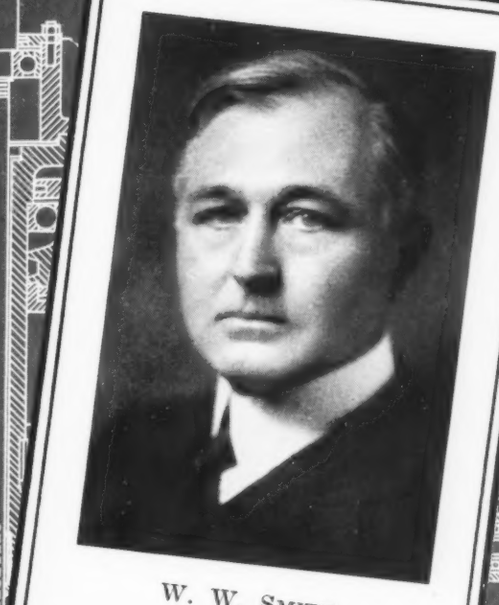
Early training at the plant of Brown & Sharpe Mfg. Co., Providence, R. I., started a career which was to mark him as an outstanding manufacturer. During the World War Mr. Burt was responsible for the equipping and successful operation of four large manufacturing plants in Toronto, Ont., and two in Buffalo, employing 12,000 operators producing shells, fuses and gun mounts. In recognition of the record made in these shops he received special mention from the British government and from the United States navy at Washington.

After the war Mr. Burt became president of the New Process Gear Co., Syracuse, N. Y., connected with the Willys Corp., and later he was made president of Austin Machinery Co., Toledo. He is a director of the National Machine Tool Builders' Association.

TO Robert E. Doherty, professor of electrical engineering and at one time an associate of the late Dr. Charles P. Steinmetz, recently went the position of dean of the newly organized

Leaders in Design, Engineering and Research

COLIN G. FINK



W. W. SMITH

—*Blackstone Studios, New York*

C. R. BURT

ROBERT E. DOHERTY

school of engineering at Yale. Originally it was Prof. Doherty's skill as a mathematician which, in 1920, attracted Dr. Steinmetz's attention to him. The two spent three years on engineering problems then confronted in electrical work of General Electric Co.

When Dr. Steinmetz's death in 1923 ended their work together, Prof. Doherty organized and had charge of the company's advanced course in engineering. He served on the general education committee of the company and in 1919 was appointed a member and later chairman of the educational committee of the American Institute of Electrical Engineers. In April, 1931, he became professor of electrical engineering at Yale.

Prof. Doherty has served as chairman of the Schenectady section of the American Institute of Electrical Engineers and as a member of the board of education of Scotia where he resided. His own education was completed at the University of Illinois from which he was graduated with a B.S. degree in electrical engineering in 1909. He received the degree of master of science from Union college in 1921.

* * *

Bancroft Gherardi, vice president of American Telephone & Telegraph Co., has retired as president of the American Standards association. His successor will be elected by mail ballot later. This announcement comes almost simultaneously with word that he has been awarded the Edison medal for 1932 by the American Institute of Electrical Engineers, for his contributions to the art of telephone engineering and the development of electrical communication. A picture and biographical sketch of Mr. Gherardi appeared in the January, 1931 issue.

* * *

F. M. Becket, vice-president and chief technical executive, Union Carbide and Carbon Co., has been nominated for the presidency of the American Institute of Mining and Metallurgical Engineers for 1933 and for director until February, 1936.

* * *

Frank S. Davis recently resigned as chief engineer of Austin Mfg. Co., Harvey, Ill.

* * *

W. J. Baumgartner recently resigned as chief engineer of Garford & Relay Motor Corp., Lima, O.

* * *

Alfred A. Gassner, formerly consulting areonautic engineer in New York, now is chief engineer of Zap Development Corp., Baltimore, subsidiary of North American Aviation Corp.

* * *

J. Kaye Wood recently was elected vice president and chief engineer of the General Spring Corp., New York. He also will resume his practice as consultant in mechanical and structural engineering specializing in design and manufacture of mechanical springs, nonresonant spring suspensions or supports, and also in solution of mechanical problems by models dynamically scaled down to size. Mr. Wood has been chairman of the American Society of Mechanical Engineers research committee on mechanical springs.

* * *

Heraclio Alforo has been appointed consultant at the Guggenheim School of Aeronautics, Massachusetts Institute of Technology. He formerly was vice president and chief engineer of F. W. Steere Co., Pontiac, Mich.

Obituaries

JOHN J. CARTY, retired vice president and chief engineer of the American Telephone & Telegraph Co., died Dec. 27 at the age of 71. He directed the research that resulted in practical long distance telephony. To carry the human voice from the Atlantic to the Pacific had been his boyhood dream. His chance came when Theodore N. Vail, upon returning to the presidency of the American Telephone & Telegraph Co. in 1907, appointed him chief engineer.

Mr. Carty realized his hopes January 25, 1915, when the New York-San Francisco telephone line was opened to the public. A picture and biographical sketch of Mr. Carty appeared in the May, 1932 issue.

* * *

George H. Isley, 50, manager of the combustion control department, Morgan Construction Co., Worcester, Mass., died recently. In 1906 he entered the employ of the Morgan company as a draftsman. For many years he was active in the gas producer department of that company, where he contributed a number of inventions and patents to the development of the producer gas machine.

NOTEWORTHY PATENTS

A Monthly Digest of Recently Patented Machines, Parts and Materials Pertaining to Design

VALVE mechanism for use in connection with a pneumatically controlled paper feed solved a problem that confronted designers of a match machine. In the unit, covered by a recent patent, stacks of pasteboard covers for "book" matches are contained in two adjacent magazines 12, Fig. 1. Bottoms of these magazines are formed by the perforated tops of horizontally reciprocating chambered slides 14, the chambers of which are exhausted constantly through an airline 18 connected with a pump.

Each succeeding lowermost match cover *C* is held flatwise on the underlying slide and is carried thereby from the magazine to a position with one end of the cover in the path of a reciprocating forming blade 26 which descends upon the cover to force the latter through a guide structure 24, fold the end of the cover, and set the fold within the adjacent link of an endless conveyor 27.

The blanks formerly were held under tremendous constant pressure on the slide to oppose the folding action of the blade, thus tending to impair the uniform formation of the fold with the machine operating at high speed. In order to overcome this objection Michael Paridon recently designed and patented for the Diamond Match Co., Baltimore, a valve which insures a high degree of vacuum to hold the cover firmly on the feed slide until the former blade initially engages the cover, and then effects a vacuum merely sufficient to prevent displacement of the match blank on the slide during the formation of the fold.

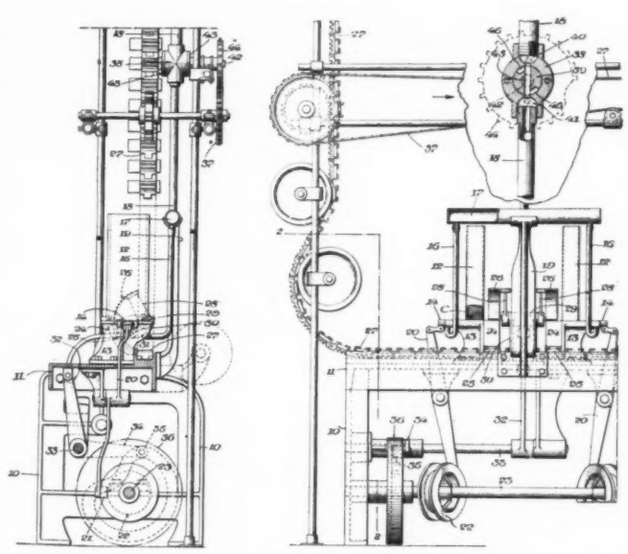


Fig. 1—Rotary valve in airline controls vacuum for holding pasteboard match covers during folding process

The new valve 38 is of the rotary type and is located in suction pipe 18. One of the journal extensions 42 is provided with a gear 44 in mesh with the upper strand of the continuously driven sprocket chain 37 which is included in the driving mechanism for the cover conveyor. The valve, therefore, is rotated in timed relation to the travel of the conveyor.

The valve body is designed with diametrical through-port 45 having at its respective ends segmental grooves 46, extending in the opposite direction from each other. These grooves are so formed in relation to ports 40 and 41 of the casing that in an interval of rotation of the valve body when the folding blades 26 are up and the slides 14 are being moved to carry the covers under the blades, full communication is afforded between ports 40 and 41. Maximum suction on the covers thus is assured.

At the moment the blades come into contact with the covers the ends of the port 45 pass across and beyond respective ports 40 and 41, thus cutting off the communication between the latter ports and releasing the covers from suction force. In rotation of the valve body as the ends of the port 45 move across ports 40 and 41, suction is reduced gradually, preventing displacement of the covers on the slides during the initial formation of the folds. The number of the patent is 1,886,496.

SPINDLE movement embodied in a cotton picker, recently patented, is designed to actuate the spindles so as to cause the effective end to travel in an elliptical path as it is introduced into and withdrawn from the plant row during travel of the machine. Edward A. Johnston is the inventor with International Harvester Co., Chicago, assignee. Another object of this movement is to present the spindles to the row of cotton plants at gradually changing angles.

Comprising the mechanism shown in Fig. 2, are a number of vertical shafts 12 aligned longitudinally in respect to line of travel.

Body 18 of housing 17 encloses a worm drive pinion 21 fixed on shaft 12. Bearing portion 19 and tubular extension 20 carry or form the

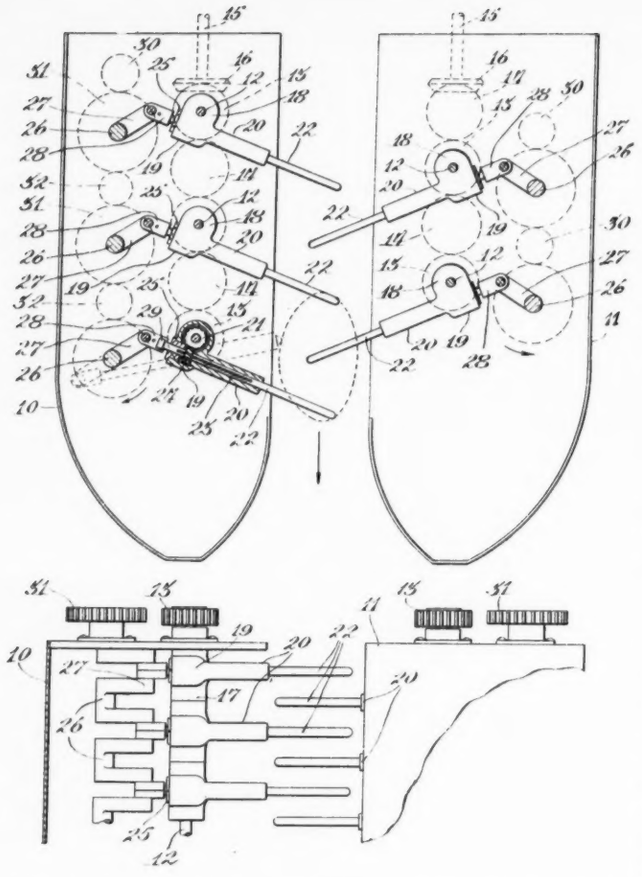


Fig. 2—(Top)—Rotating and reciprocating spindle mechanism of cotton harvester. (Below)—Front elevation

bearing for picker spindle 22. This spindle is mounted for reciprocation and rotation in the carrier, and in order that it may be reciprocated while being rotated, the spindle is provided with a spline groove 23. It carries a worm pinion 24 which is located in bearing portion 19 of the carrier and is provided with a key slidable in the spline groove.

Pinion 24 is in mesh with and driven by worm drive pinion 21. An end plug or bushing 25 is threaded into the enlarged end portion of bearing housing 19 and abuts pinion 24 to retain it in position. At the rear of each of shafts 12 there is journaled in the housing a series of vertical crankshafts 26.

Rotation of crankshaft 26 will effect reciprocation of spindle 22, moving it in the manner indicated by the dotted lines in Fig. 2. As the direction of travel is that indicated by the arrow, the spindle will be projected into the row of cotton at a forwardly directed angle, as shown by the full lines of the drawing, and will be moved to the rear gradually at changing angles and finally withdrawn into the tubular extension 20 until it attains the position shown by the dotted lines. As the spindle is reciprocated by rotation of crank 27, the spindle carrier or housing 17 will be rocked on shaft 12, and reciprocation and rocking movements will in no way interfere with constant rotation of the spindle. The number of the patent issued for the unit is 1,888,505.

LUBRICATION by both pressure and gravity is one of the features provided by a system recently patented by the Cleveland Tractor Co., Cleveland. The arrangement, designed particularly for tractors, provides for straining and distributing the oil.

Gears 30, Fig. 3, run in a bath of cil, as the wall 23 is provided with openings 39 sufficiently high to maintain a body of oil in the compartment for this purpose. Oil will overflow by gravity through openings 39 into compartment 19, the bottom of which is at a considerably lower level.

The distributor 41 is secured to the top wall of the transmission casing. A pump is arranged to lraw oil from the compartments 20 and 21 (not shown) and move it through the distributor from which it flows into compartments 18, 19.

The strainer unit inside the distributor casing embodies a perforated core surrounded by a helical screen 59. Associated with duct 60 is a spring pressed valve 70 which normally prevents oil passing into the end of the core except when pressure in the system requires relieving. Ordinarily oil passes from port 50 through duct 61 in the head and into the casing where it must pass through the screen and core before leaving through openings 63 and outlet 51 in the distributor casing. The patent is No. 1,858,533.

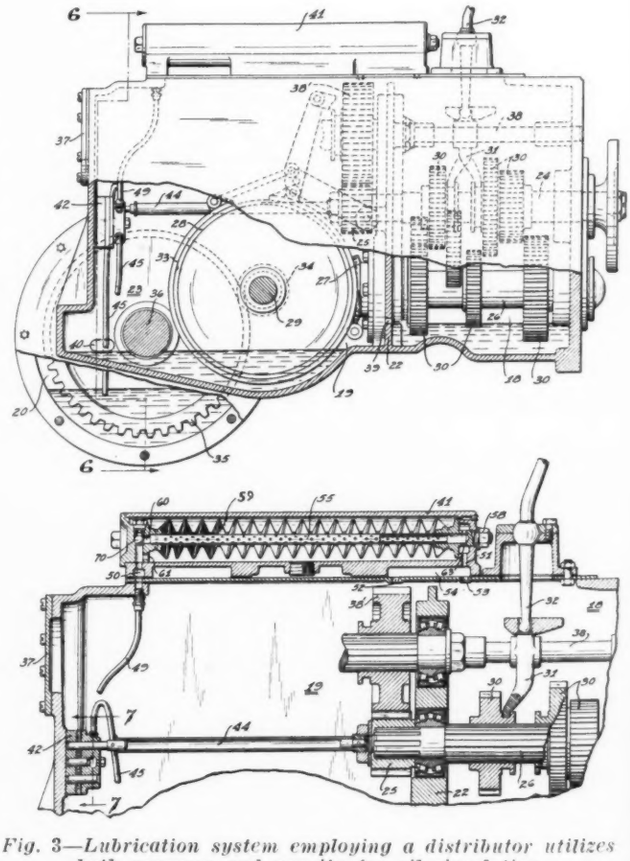
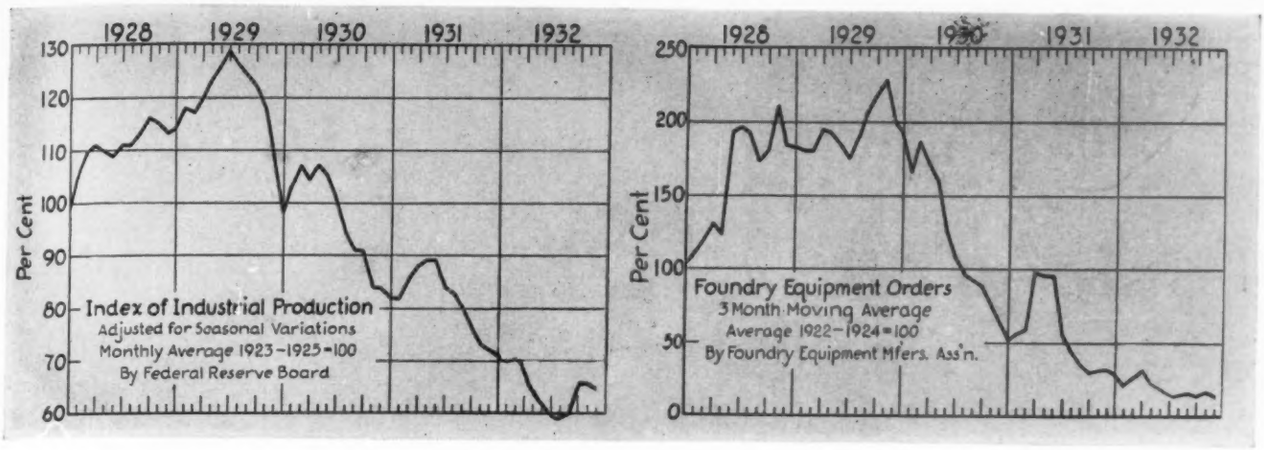


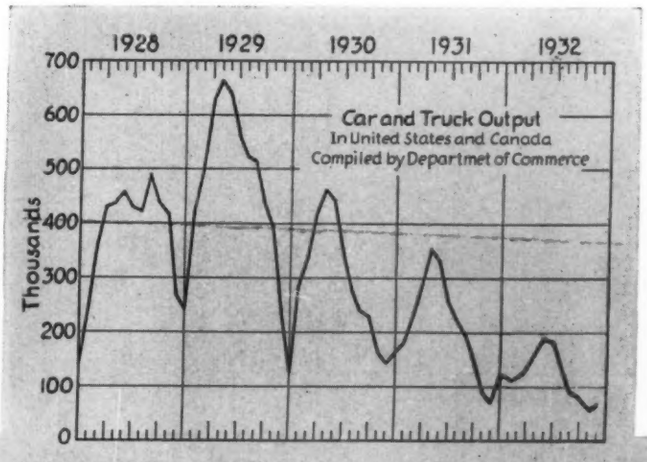
Fig. 3—Lubrication system employing a distributor utilizes both pressure and gravity for oil circulation

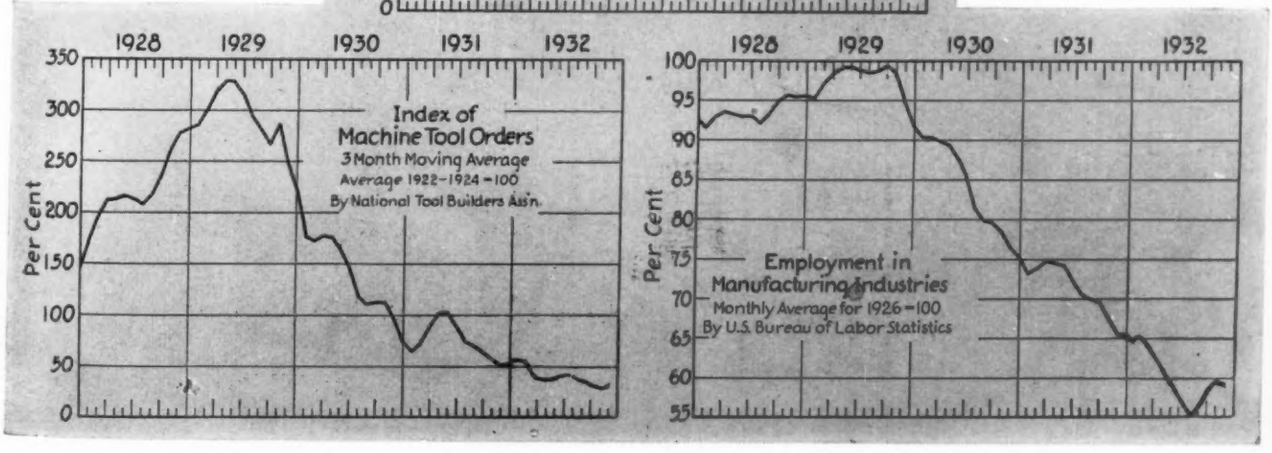


How Is Business?

WITH activities of Congress still in a highly problematical stage, business is proceeding with extreme caution. Banking reform, legalization of beer, currency inflation and other factors both good and bad are being considered. Just how good or how bad any of these developments will be for business no one can say, with so many intangibles imminent time alone will tell. In the manufacturing industries, the pent-up demand for equipment is daily growing larger. It is a known fact that the plant with antiquated machinery cannot compete in fields where profit margins are narrow. In order to compete profitably when demand improves, practically every manufacturing plant in the country will find it necessary to order new, improved equipment, thus further assisting the upward acceleration.

At the present time, many small manufacturers are faring much better than the large ones. These organizations, for example, are able to go into the market and buy castings for a price well below that for which the large manufacturer could make them in his own shop. With advantages of this sort combining to make production costs lower, it is a comparatively simple process for the small manufacturer to compete successfully in competition for contracts. A little success of this nature permits the purchase of improved machinery and still further savings in production costs. Considering such factors, it is little wonder that the smaller plants have taken the lead toward business improvement.





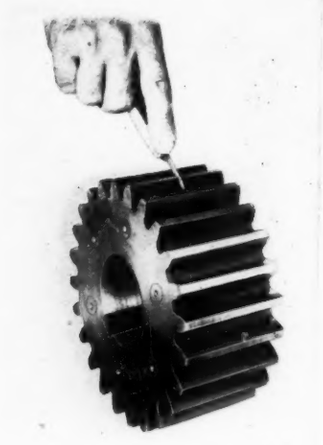
NEW MATERIALS AND PARTS

Worthy of Note by Those Engaged in the Design of Mechanisms or Machines

Gears Are of Laminated Steel

ALL steel gears and gear blanks especially designed for use where silence is desired have been announcd by John Waldron Corp., New Brunswick, N. J. The gears, shown herewith, are built up of many thin pieces of sheet metal, coated with graphite and subjected to tremendous pressure. They have the appearance of a ground steel gear of ordinary construction. The strength and life of steel are combined with silent service and self lubrication.

In service the gears take on a glass-like polish



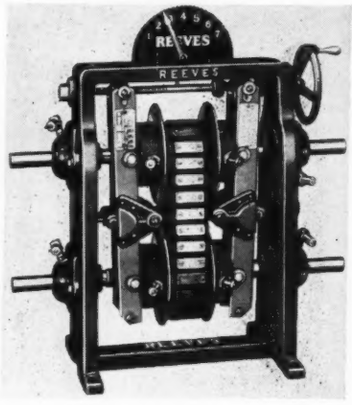
Gears are built up of many thin pieces of sheet metal coated with graphite and assembled under pressure

on the teeth. They may be run in mesh with each other, or they may be run in mesh with any gear commonly used as a mating gear for silent pinions. Gears or gear blanks can be supplied.

Develops Small Variable Speed Drive

DEVELOPING especially for incorporation in an upright position directly into a machine requiring speed regulation, the new variable speed transmission and vari-speed motor pulley brought out by Reeves Pulley Co., Columbus, Ind., is extremely small and compact. This size No. 0000, shown herewith, is the smallest vertical design ever built by the company.

The unit may be equipped with motor base and individual driving motor, with auxiliary countershaft for greater speed reduction, and with extended lever type mechanical automatic control. It also is available in completely enclosed design for protection of operating parts against destructive elements such as water, live



Extremely small variable speed transmission is available in completely enclosed designs

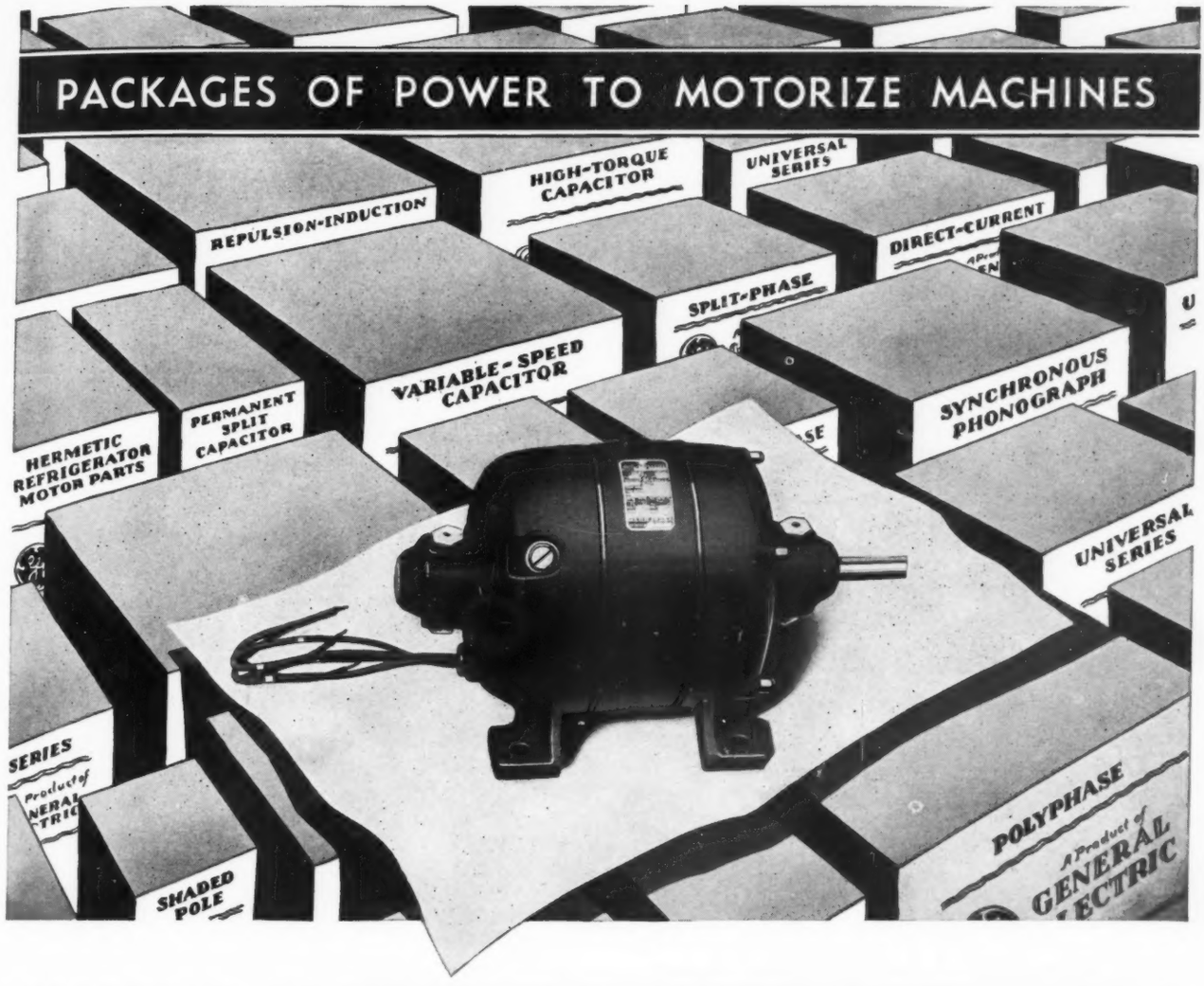
steam, chemical fumes, dust and abrasives. Speed range of the new unit is from 2:1 to 6:1 inclusive. Horsepower capacity is from ⅛ to ¾.

Electronic Cell Requires No Battery

AN IMPROVED self-generating type of photoelectric cell for general applications and service in the laboratory, commercial and indus-

Cell can be used with a sensitive relay and auxiliary relay to turn on and off power currents

trial fields has been brought out by J. Thos. Rhamstine, 516 East Woodbridge, Detroit. The cell, shown herewith, is of the dry disk type and



EXAMPLE 8—FOR FLOOR MACHINES. General Electric builds exactly the *right* motor to meet every requirement — a motor that is efficient and dependable. Nation-wide use of General Electric motors is undeniable evidence of their proved value.

The motor shown here is further evidence of the ability of General Electric to build fractional-horsepower drives — not only for floor machines, but for any need of present-day motorized equipment.

Whether you are considering a new design of your motorized product, or simply a different type or size of drive for your present design, it will pay you many times over to get in touch with your nearest G-E office. General Electric Company, Industrial Department, Schenectady, New York.

210-188

GENERAL ELECTRIC

ALLEN

TRI-MARKT

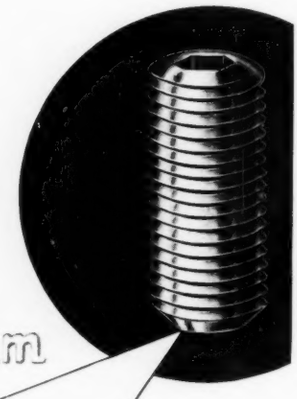
TRADE MARK

HOLLOW SCREWS

of

Chrome-

Mo-lyb-den-um



They get the hard jobs and tough breaks — they're made and *priced* for just that!

DESIGNERS, engineers, production men know that hollow screw breakage is more expensive than the most expensive hollow screws. They habitually pick ALLENS for the hard jobs and tough breaks — which Allens bear without breakage and down-time expense. Many makes of hollow screws are good enough for some purposes, but it's so hard to draw the safety-limit that it's vastly safer to use Allens for ALL purposes. » »

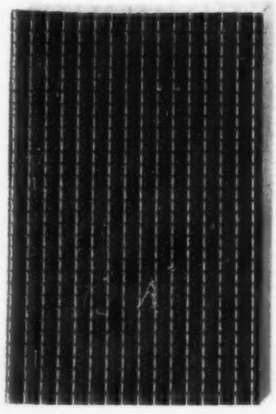
THE ALLEN MFG. COMPANY

HARTFORD, CONN. U. S. A.

transforms light energy directly into electrical energy without the aid of batteries or any other source of electromotive force. The self-generated current is always directly proportional to the light intensity.

Belt Has Special Non-Skid Surface

LEATHER belting with a non-skid surface produced by pressing down or indenting part of the surface of the belt is a recent development of E. F. Houghton & Co., Third American and Somerset streets, Philadelphia. The surface of



Tension between the belt and the pulley is concentrated on the ribs of belt in recently introduced non-skid design

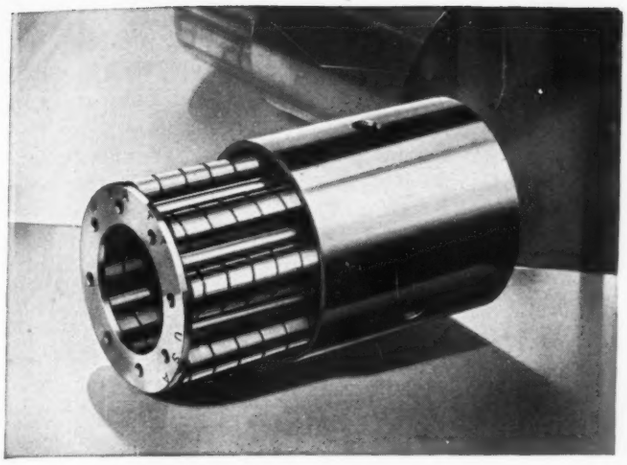
the belt, shown herewith, concentrates the tension between the belt and the pulley on the ribs of the surface without increasing the total tension of the belt, thus giving greater resistance to slippage without greater stress in the belt itself. The indentations in the surface of the belting permit trapped air to escape.

Announces Improved Motor Lines

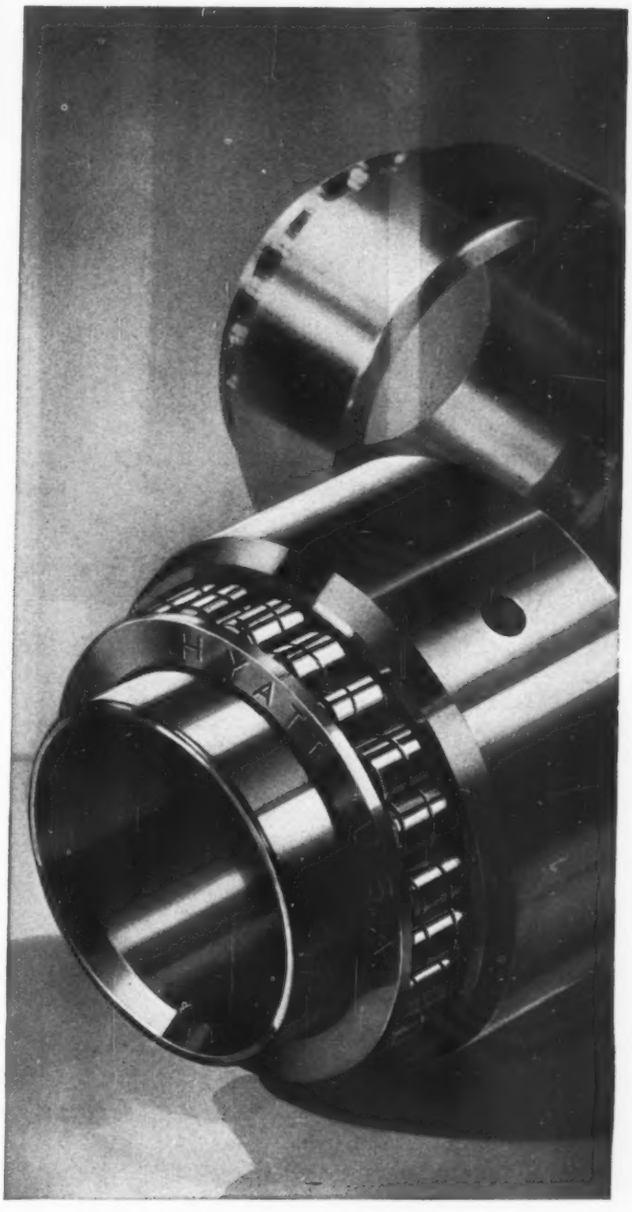
SPLIT phase and electrolytic start motors in complete lines have been introduced by Leland Electric Co., 1501 Webster street, Dayton,

Split phase motor is suitable for applications where quiet is required

O. The split phase motor, shown herewith, is type KS, form KSA rigid mounting and KSAT cradle rubber spring mounted. It is recom-



Illustrated at left, Hyatt Split Outer Race Bearings. Below, the Hyatt Standard Series Bearing.



Again and Again

Another year sees an increasing preference for Hyatt Roller Bearings. Outliving many changes in equipment and methods, Hyatts remain the constant choice of critical manufacturers.

In this we take great pride, at the same time realizing the responsibilities involved. For to build bearings in keeping with the high standards of excellence established by leading builders is an exacting job.

And our way of meeting these demands is through the definite control of quality maintained in every stage of Hyatt design and manufacture. Hyatt Roller Bearing Company, Newark, Detroit, Chicago, Pittsburgh, Oakland.

H Y A T T

ROLLER BEARINGS

PRODUCT OF GENERAL MOTORS

Fastening Question and Answer No. 1

What is the Cheapest Way to join Thin Sheet Metal?

TO do it with machine screws calls for that s-l-o-w costly tapping operation with its breakage of taps, crossed and mistapped threads, etc. Often it is necessary to build up the metal with tapping plates and other auxiliary fastening devices. To use bolts and nuts, rivets and the like, means sacrificing assembly speed or fastening security.

That's why thousands of manufacturers use Hardened Self-tapping Sheet Metal Screws . . . the cheapest and quickest means of making such fastenings. You just turn them into holes, drilled or punched in the metal. Tests prove, too, that these unique Screws hold better than machine screws or nuts and bolts.

For example, on Hotpoint Range assemblies, Self-tapping Screws eliminated many tapping plates with large savings. Used in place of machine screws for assembling metal furniture, Doehler gets better fastenings and saves 33% to 50% in labor.

And not only do they lower sheet metal fastening costs, but these Screws offer equal advantages in making fastenings to aluminum and die castings, Bakelite, slate, ebony asbestos, etc. Try them . . . the coupon will bring proper samples.

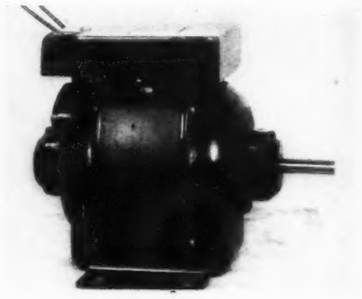
PARKER-KALON
HARDENED TYPE Z SELF-TAPPING
Sheet Metal Screws
PATENTED—No. 1809758, No. 1827615

Parker-Kalon Corp., 202 Varick St., New York, N. Y.
Send trial samples with recommendations for making fastenings briefly described on attached sheet.

Name and title .....
Company .....
Address .....

mended by the company for any application requiring a motor of quiet operating characteristics, normal torque and light starting torque such as ventilating equipment, oil burners and fans.

The electrolytic start split phase motor is known as type KL, form KLA rigid mounting,

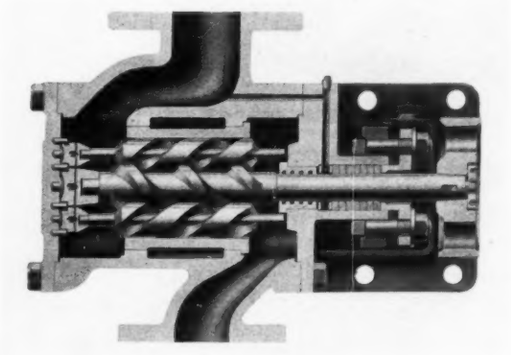


Electrolytic start motor is used with oil burners, stokers and similar equipment

and form KLAT cradle rubber spring mounted. The company recommends this type for oil burners, stokers or refrigerator applications where exceedingly quiet operating characteristics and moderately high torques are required. The box containing the electrolytic condenser is fastened to the top of the motor stator. There is no necessity of mounting the box separately as noise from vibration has been eliminated. Start to run changeover is accomplished by a specially designed mechanical switch. The motor is available in 1/8, 1/6 and 1/4 horsepower ratings.

Pumps Do Not Require Valves

NO VALVES, no pilot gears and no separate bearings are required on the new type of rotary displacement pump designed by De Laval



Rotary displacement pump of new type requires no valves or pilot gears

Steam Turbine Co., Trenton, N. J., which has only three moving parts and one stuffing box. Power is applied to a central or power rotor, shown in the accompanying illustration, which

1/6 Horse Power Century Repulsion Start Induction Single Phase Motor.

Protection... Century Fractional Horse

Power Motors are specially designed so that dirt, falling objects or dripping water will not enter the motor. One look tells the story.

Workmanship... Neat, Careful Workmanship

is evident in every detail. Century motors are built by specially trained mechanics, many of whom have been with the Company since it was founded in 1904. They know how to build motors that last.

Materials... Careful Selection of Best Materials

—strong rigid frames, electrical sheet steel laminations, steel shafts ground to sizes and polished on all bearing surfaces, thick walled phosphor bronze bearings and the Century Wool Yarn System of Lubrication—

Century MOTORS

These are only a few reasons why Century Motors give years of uninterrupted service, in all types of installations, in all climates, in all parts of the world. Whether you buy or sell motors be sure to insist on Century.

CENTURY ELECTRIC COMPANY, 1806 PINE STREET, ST. LOUIS, MO.
Offices and Stock Points in Principal Cities

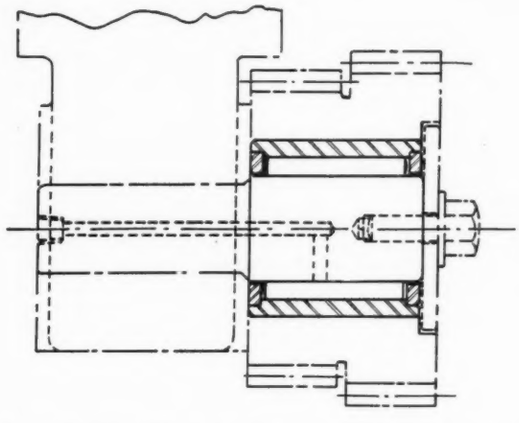
CENTURY MOTORS ARE BUILT IN ALTERNATING AND DIRECT CURRENT, SINGLE PHASE, POLYPHASE, SPLIT PHASE, MULTISPEED AND SPECIAL MOTORS RANGING IN SIZE—DEPENDING ON TYPE—FROM 1/250 TO 600 HORSE POWER, 3600 R. P. M., ALSO MOTOR GENERATOR SETS, ROTARY CONVERTERS AND FANS.

Is yours one of the 545 applications for Small Motors?
Then be sure the motor you use will give the maximum service. The success of your product—its ability to repeat with users—depends upon the motor, the heart of the appliance.
Signal motors are made for your particular application. They are not stock type motors, and the reason they cost no more is that the entire motor is made in the Signal factory—not merely an integral part.
Your specifications will enable us to furnish you complete information on Signal small motors — designed to meet your specific requirements.
SIGNAL ELECTRIC MFG. COMPANY
Menominee, Michigan
SIGNAL
MANUFACTURERS OF ELECTRICAL PRODUCTS

meshes with one or more sealing rotors of such form that they are propelled largely by fluid pressure with a minimum of mechanical contact. This action results from the shape of the threads, those of the power rotor being convex, while those of the idler rotor are concave. The pumps are available in capacities ranging from ½ to 700 gallons per minute and for pressures up to 500 pounds per square inch.

Small Rollers Available for Bearings

SMALL rollers, suitable for use in a large number of bearing applications are being manufactured in a complete line by Bantam Ball Bearing Co., South Bend, Ind. These rollers are used



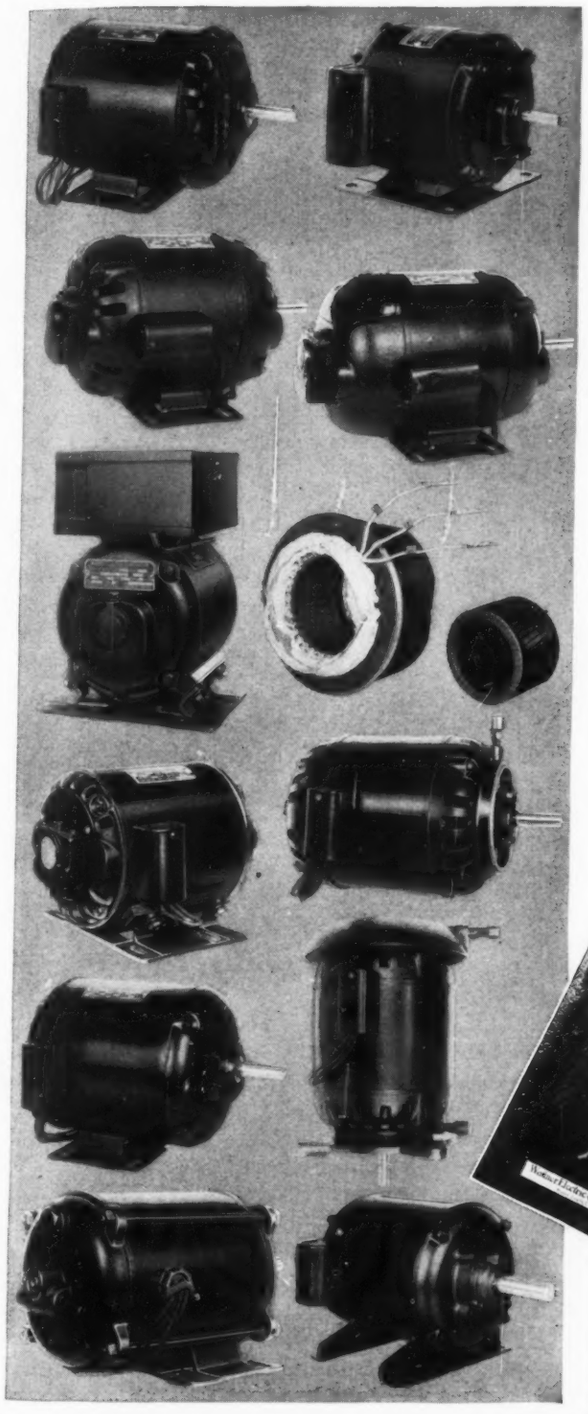
Typical application of small rollers made in a printing press gear bearing

where limited space and peculiar operating conditions require greater bearing capacity than is permitted by other bearing types. Applications include universal joints, diesel engine piston pins and crankshafts, high speed marine engines, printing presses, gears, pumps, transmissions, small rolling mills, high speed drills and tools, automotive brakes, rocker arms and similar installations. The rollers are available in sizes ranging from 0.0625 to 0.188-inch diameter and tolerances of plus or minus 0.0001-inch to plus or minus 0.0002-inch.

In the announcement on small sized ball bearings presented on page 58 of the November MACHINE DESIGN it was stated in connection with the bearing having a ½-inch outside diameter and ⅛-inch bore that, "The miniature design is said to be the smallest, lightest ball bearing ever made." This description should be corrected as the Norma-Hoffmann Bearings Corp., Stamford, Conn., has been manufacturing a ball bearing with ⅜-inch outside diameter and ⅛-inch bore for some time.

Diversified

to meet all small-motor requirements

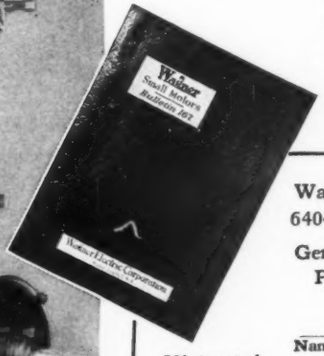


A line of small motors intended for application on motor-driven machinery must include all the electrical and mechanical types required by the machinery-manufacturer—for a *single* source of *all* types is far more desirable than a number of sources of incomplete lines of motors.

The Wagner line includes all types of small motors generally applied on motor-driven machinery, making it possible for machinery-manufacturers to standardize on Wagner motors. Whether alternating or direct current; single or polyphase; open, drip-proof, totally enclosed or explosion-proof; rigid or rubber-mounted, flange-mounted or built-in; sleeve or ball-bearing; horizontal or vertical—there's a Wagner motor now in existence, ready to be applied on the job.

There are 25,000 *different type-horsepower-speed combinations of Wagner motors (in ratings up to* 400 *hp). Certainly, your motor requirements are no greater than that!*

For complete details, ask for Bulletin 167 describing Wagner small motors.



S432-2

Wagner Electric Corporation
6404 Plymouth Ave., St. Louis, Mo.

Gentlemen:
Please send copy of Bulletin 167 on small motors

Name and Position

Firm

Address

If interested also in large motors, indicate here ☐

Wagner Electric

MOTORS TRANSFORMERS FANS BRAKES

Over 350,000
Viking Pumps
are faithfully serving Hundreds of Industries

Viking Rotary Pumps . . . over 350,000 of them . . . are serving every conceivable industry where the quick and economical handling of a grit-free liquid is involved. They range in size from tiny fuel oil burner pumps to giants with a capacity of 1,050 G. P. M. Made in standard, sanitary, steam-jacketed and hazardous liquid models. Viking Hydraulic Pumps have found favor in those fields requiring hydraulic oil pressures up to 500 lbs. per square inch. Viking Coolant Pumps have likewise proven their popularity through efficiency. All Viking Pumps incorporate the famous Viking "Two Moving Parts" principle. All are sturdy in construction, economical in original cost and upkeep. They enjoy a world-wide reputation for trouble-free service and long life. Tell us what your pumping problem is and we will recommend the proper Viking to handle the job.

Viking Pump Company
Cedar Falls, Iowa

1932 INDEX

The index for 1932 issues now is ready for distribution. In addition to the usual contents index, the issues for the year also are covered by a combined itemized index.

There is no charge for the index. However, it will be sent only to those who request a copy. Write MACHINE DESIGN, Penton Building, Cleveland.

TOPICS OF THE MONTH

(*Concluded from Page* 41)

um produced by the passage of steam at high velocity through the throat of a venturi tube causes the water in the drum to evaporate at 45 degrees Fahr. This evaporation produces the required cooling effect.

During the period in which the show was in progress the American Society of Mechanical Engineers held its annual meeting. Features of this meeting as well as others pertaining to the power show may be found elsewhere in this and subsequent issues of MACHINE DESIGN.

* * *

Berlin Streamlined Train Sets World's Record

SPEED records for rail cars flourish abroad. In Berlin a new world's record for fast passenger train speed has been established by a streamlined speed car designed by the German Railways Co. The car, driven by two Maybach diesel engines, covered the 180 miles between Berlin and Hamburg in 2 hours and 20 minutes. This Hanseatic flyer, as it is called, made an average speed of 91 miles an hour running time, compared with 76 miles made by the Great Western flyer between London and Swindon, until then the world's fastest train.

The return trip to Berlin was made in the same time. Painted in brilliant violet and ivory, the train is 137 feet long and consists of two cars linked together by folding bellows. The cars accommodate 100 passengers, being built on the American principle with seats on each side of the aisle instead of in compartments as with most European lines.

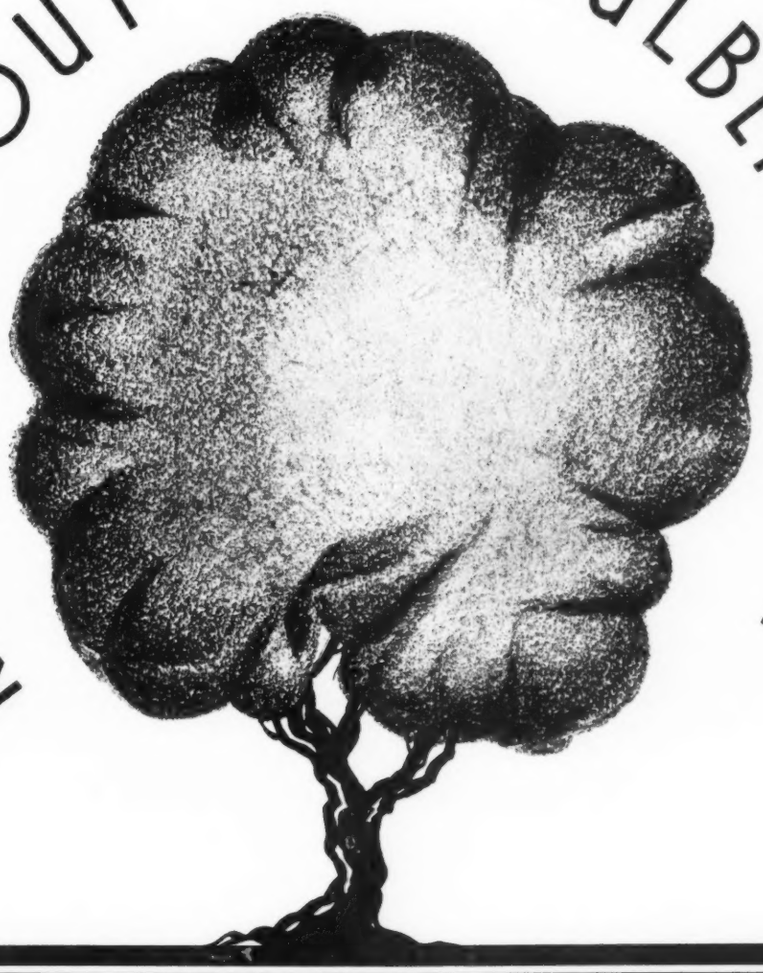
* * *

Offers Plan to Put Men Back to Work

TO MAKE more effective the President's rehabilitation plan under A. W. Robertson, Louis Allis, president, Louis Allis Co., Milwaukee, has broadcast an idea that promises to have a widespread influence on the movement to put men back to work. Warner & Swasey Co., Cleveland, also is promoting Mr. Allis' plan.

Visualizing its main purpose as increasing employment, Mr. Allis' campaign is intended to insure that equipment ordered for plant rehabilitation be built now or, if shipped from stock, that such equipment and corresponding raw materials be replaced immediately or corresponding shop orders issued. P. E. Bliss, president, Warner & Swasey Co., recently issued a statement of policy in which he says, "We have a substantial number of turret lathes finished and in stock. Nevertheless, for each machine purchased from us we will put men to work immediately building a new one of equivalent value in order to increase employment."

'ROUND ABOUT THE MULBERRY BUSH



Here's the way it goes (not the tune, but the words):

The Boss: "Let's replace that P-7178 with a new model that will do so-and-so and such-and-such."

Yourself: "Okay, Boss"!

(Months pass, during which you give birth to P-7179 —a honey, a looloo and a ding-twister all rolled in one—certainly a great piece of equipment!)

(The curtain falls for a brief darkness of, say seven weeks!)

The Boss: "Hey you—what about this complaint from Bronx, Bronx, Honx and Kronx on that new P-7179 of theirs?"

Yourself: "Don't know, Boss. They must not run her right. She certainly stands up in our tests. Can't understand three breakdowns in two weeks myself."

'Round About the Mulberry Bush!

You design it right and the users run it wrong!

Certainly YOU know the answer. At least you will in a second. Design Alemite High Pressure Lubrication Systems INTO your product—DEFINITELY SPECIFY THE CORRECT ALEMITE LUBRICANTS TO BE USED (don't worry—we'll tell you the correct ones)—THEN if there is trouble, it's because the users didn't follow your instructions.

SIMPLE? It's A-B-C!

ALEMITE CORPORATION (Division of Stewart-Warner) 2644 N. Crawford Avenue, Chicago, Illinois 660

Gentlemen: I am interested in information regarding Alemite Systems and Lubricants from the designer's standpoint.

Name..... Company.....

Address..... City..... State.....

PIONEERS IN SPECIALIZED LUBRICATION FOR INDUSTRY

Business and Sales Briefs

George C. McMullen has joined the Tyson Roller Bearing Corp., Massillon, O., as manager of industrial sales. Mr. McMullen has been associated in sales and engineering capacities with Timken Roller Bearing Co., and Timken Detroit Axle Co.

* * *

The Chicago district sales office of Detroit Seamless Steel Tubes Inc., Detroit, is now located at 1768 First National Bank building. L. R. Phillips is district sales manager.

* * *

Rawlplug Co. Inc., New York, has removed its Cleveland office and warehouse to 1315 West Sixth street, Cleveland.

* * *

William J. O'Meara has been appointed engineer of the Baltimore office of General Electric Co.

* * *

Koehring Co., Milwaukee, has been granted a license to manufacture Meehanite castings exclusively in that territory.

* * *

E. K. Blackford has been appointed Seattle district sales manager for the Youngstown Sheet & Tube Co., Youngstown, O., succeeding A. G. Oakley who has been transferred to the San Francisco office.

* * *

R. H. Garrison, former general sales manager for Universal Motor Co., Oshkosh, Wis., has become associated with Marble-Card Electric Co., Gladstone, Mich., manufacturer of electrical machinery as vice president in charge of merchandise.

* * *

Ralph Kelly, formerly southwestern district manager has been appointed central district manager of the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., with headquarters in the Gulf building, Pittsburgh.

* * *

E. J. von der Heide will handle sales of gears, gear units and gear generators in the middle West for Farrel-Birmingham Co., Ansonia, Conn. His headquarters are located at 824 Miami Savings building, Dayton, O.

* * *

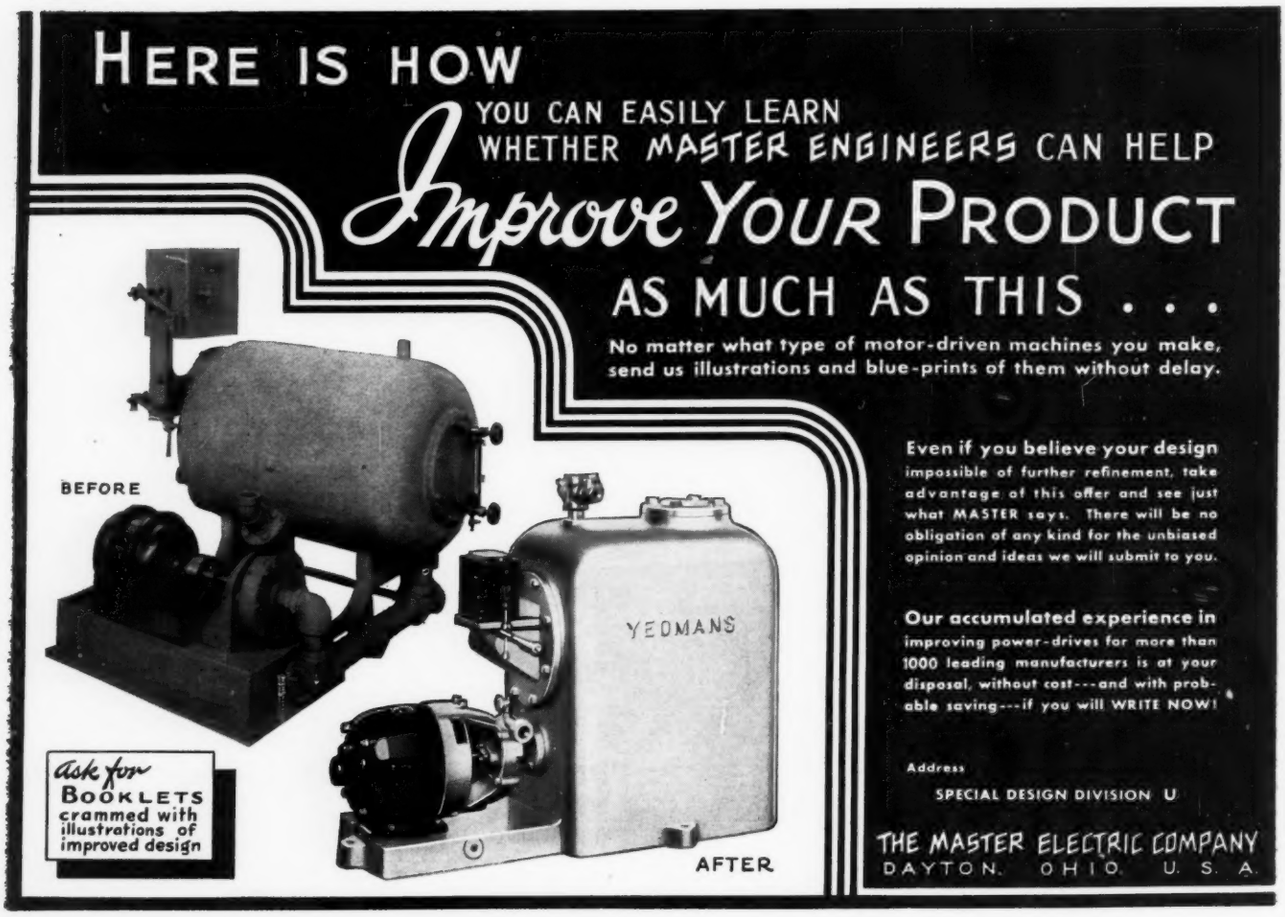
George M. Sharer is now sales manager of the eastern division of Link-Belt Co., with headquarters in Philadelphia. Mr. Sharer, a mechanical engineer, has been connected with the company in Philadelphia for the past 32 years.

* * *

Research & Mfg. Corp., 900 Victory building, Philadelphia, has been formed to assist laymen inventors and manufacturers lacking research departments. Joseph S. Pecker, consulting engineer, is president of the new organization.

* * *

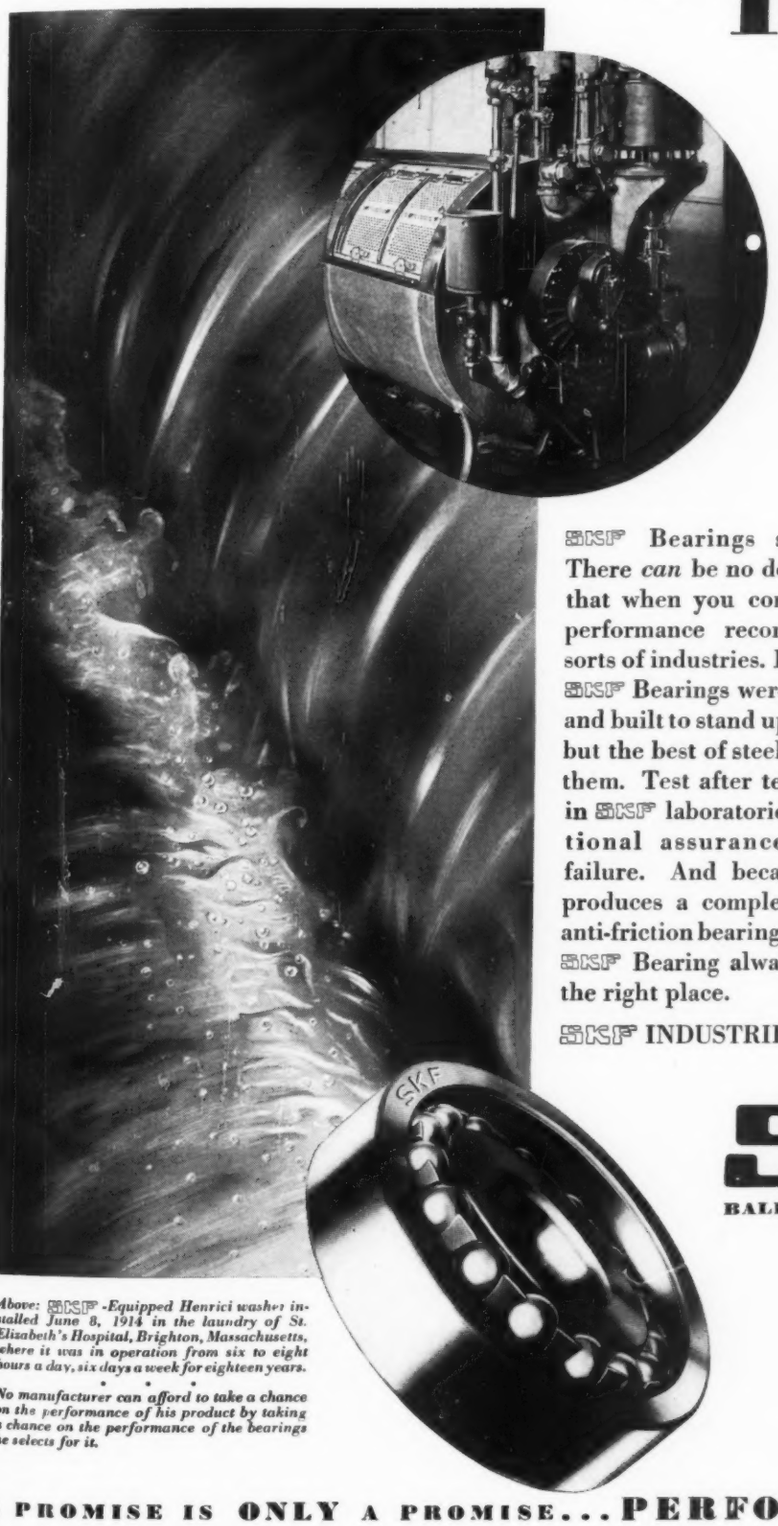
Gould's Pumps Inc. has acquired the Hydroil Corp., Lebanon, Ind., manufacturer of oil purifying apparatus. The Lebanon plant is being discontinued and the business and equipment transferred to the Seneca Falls plant of the Gould company. D. B. Clark, vice president of Hydroil and W. P. Alexander, factory and field representative will join the Gould organization which will continue to manufacture the Hydroil equipment.


HERE IS HOW
YOU CAN EASILY LEARN
WHETHER MASTER ENGINEERS CAN HELP
Improve Your PRODUCT
AS MUCH AS THIS . . .
No matter what type of motor-driven machines you make, send us illustrations and blue-prints of them without delay.
BEFORE
YEOMANS
AFTER
Even if you believe your design impossible of further refinement, take advantage of this offer and see just what MASTER says. There will be no obligation of any kind for the unbiased opinion and ideas we will submit to you.
Our accumulated experience in improving power-drives for more than 1000 leading manufacturers is at your disposal, without cost---and with probable saving---if you will WRITE NOW!
Ask for BOOKLETS crammed with illustrations of improved design
Address
SPECIAL DESIGN DIVISION U
THE MASTER ELECTRIC COMPANY
DAYTON. OHIO. U. S. A.

SWISH . . . SWISH . . .

sang this WASHING MACHINE

for 18 YEARS



. . . AS IT ROCKED ON THE SAME SET OF SKF BEARINGS

SKF Bearings stand up. There *can* be no doubt about that when you consult their performance records in all sorts of industries. But then... SKF Bearings were designed and built to stand up. Nothing but the best of steels goes into them. Test after test is made in SKF laboratories as additional assurance against failure. And because SKF produces a complete line of anti-friction bearings, the right SKF Bearing always goes in the right place.

No wonder, then, that SKF performance stories continue to come in...stories that range all the way from SKF Bearings that have stood up under a million miles of railway service down to stories of dime-sized SKF Bearings that have performed up to SKF standards in some delicate, scientific instrument.

More than ever before, manufacturers are finding today that it costs more to replace a poor bearing than to buy the best that SKF has ever produced.

SKF INDUSTRIES, INC., 40 East 34th St., New York, N. Y.

SKF

BALL AND ROLLER BEARINGS

Above: SKF-Equipped Henrici washer installed June 8, 1914 in the laundry of St. Elizabeth's Hospital, Brighton, Massachusetts, where it was in operation from six to eight hours a day, six days a week for eighteen years.

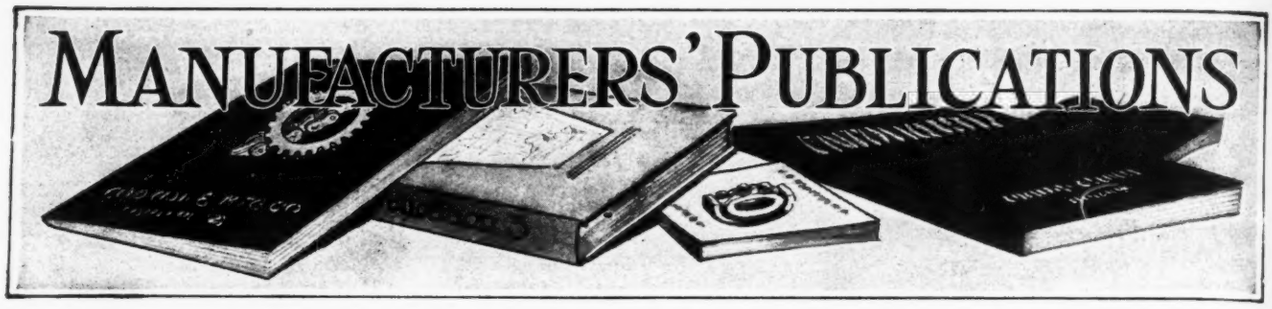
* * *

No manufacturer can afford to take a chance on the performance of his product by taking a chance on the performance of the bearings he selects for it.

2937

A PROMISE IS ONLY A PROMISE . . . PERFORMANCE IS HISTORY

MANUFACTURERS' PUBLICATIONS



Publications listed in this section may be obtained by engineers responsible for design from the manufacturers of the products or through MACHINE DESIGN

BERYLLIUM COPPER—American Brass Co., Waterbury, Conn., presents in its bulletin B-21 complete information on Anaconda beryllium copper. The bulletin gives authoritative data on composition, physical properties, fatigue resistance, hardness, density, electrical conductivity and production operations for this heat treatable copper alloy.

CAST PARTS—A guide designed as a convenient source from which suitable alloy cast iron compositions may be selected for specification purposes has been prepared by International Nickel Co. Inc., New York. This is the first of a series of data sheets covering composition and service data on industrial applications of nickel cast iron. The sheets will provide assistance in selecting a composition which will produce suitable physical characteristics in a casting of a given thickness of section.

DRIVES—A new 4-page catalog insert on Longlife V-belts designed for fractional horsepower has been prepared by B. F. Goodrich Rubber Co., Akron, O. The insert describes two types of V-belt construction and lists dimensions of the belts for various installations.

DRIVES—Motorized speed reducers are covered by a leaflet on the Sterling system of direct power application prepared by Sterling Electric Motors Inc., Los Angeles. Sizes and types available and photographs of applications are included.

DRIVES—Roller chain drives manufactured by Morse Chain Co., Ithaca, N. Y., are presented in a new bulletin, No. 31, of the company. This well prepared publication includes a section on "How to Design Roller Chain Drives," which gives the formulas and tables necessary. Specifications for all types of roller chain together with their sprockets are included.

DRIVES—Reeves Pulley Co., Columbus, Ind., has prepared a comprehensive booklet on automatic variable speed control of both the electric and mechanical types. The 18-page booklet covers the drives completely, giving considerable detail on the various units available and how and where they can be applied.

GEARS—John Waldron Corp., New Brunswick, N. J., is distributing bulletin No. 71 on its line of silent steel gears. These gears are built up of many thin pieces of sheet metal, coated with graphite and subjected to pressure. They have the appearance of a ground steel gear of ordinary construction.

MOTORS—Lincoln Electric Co., Cleveland, has issued a bulletin on its Linc-Weld type D motor. The bulletin goes into detail on the construction features of the motors and gives cross sectional drawings and dimension tables.

MOTORS—General Electric Co., Schenectady, N. Y., is issuing bulletin GEA-1191A on its line of synchronous motors. The motors, their operating characteristics, applications and similar information are presented completely.

STEEL (METAL-CLAD)—Ingersoll Steel & Disc Co., Chicago, has issued a folder describing the composition, method of manufacture and fabrication of stainless clad steel. The folder also includes illustrations and listing of applications for this corrosion resisting material.

WELDED PARTS AND EQUIPMENT—Methods of achieving a welded design for clevises and pins are brought out in detail in application sheet No. 32, series 2, of Lincoln Electric Co., Cleveland. Application sheets issued previously by the company and those to be issued in the future may be obtained on application.

Research Publications

Index to A. S. T. M. Standards and Tentative Standards. A complete listing of specifications, methods of testing, recommended practices, definitions of terms, and charts and tables. Published by American Society for Testing Materials, 1315 Spruce street, Philadelphia. 105 pp.

Report on Comparative Load-Displacement Tests on Butt and Lap Joints Assembled with Dardelet "Rivet-Bolts" and Hot-Driven Rivets. Two reports on comprehensive tests are included in this publication. The tests were to determine the utimate tensile strength and the behavior of the various joints under tensile loads. Rivet-bolts composed of structural rivet steel, Lloyds rivet steel and manganese steel were tested and total displacement set at working loads was determined. Results are given both in tabular form and graphically. Published by Columbia University. Available through Dardelet Threadlock Corp., 120 Broadway, New York. 32 pp. Free.

National Directory of Commodity Specifications. The second revised edition of this publication, prepared with the assistance of an advisory board consisting of representatives of fourteen national organizations, lists by title, designating number and sponsoring organization, standards and methods of test for all commodities regularly produced in this country. Each specification also is summarized briefly as to technical characteristics, scope and special applications. The enumeration of standards and specifications is limited to those adopted by national, technical and trade associations and those agencies which speak with the authority of the Federal government. Available through Superintendent of Documents, Government Printing Office, Washington. $1.75.